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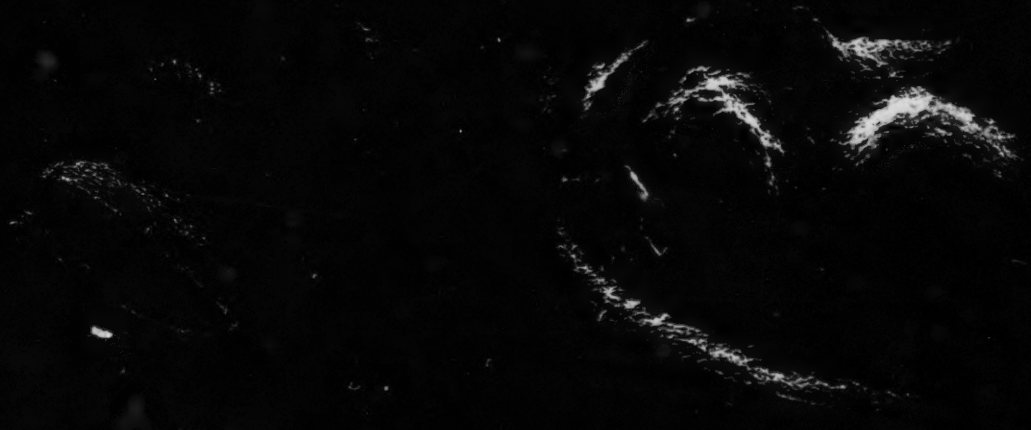
SILICIFIED UPPER ORDOVICIAN — LOWER SILURIAN OSTRACODES FROM THE AVALANCHE LAKE AREA, SOUTHWESTERN DISTRICT OF MACKENZIE

M.J. Copeland



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Cover

Left
Avalanchella bicristata n. sp.
left valve
Silurian, Delorme Formation

Right
Delormobolbina binodosa n. sp.
right valve
Silurian, Delorme Formation

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PREFACE

This report describes a silicified ostracode fauna from platform carbonates of the Whittaker and Delorme formations of the Selwyn Basin. The fauna can be used to restrict the Ordovician - Silurian boundary within the Whittaker Formation and to correlate the platform carbonates with the basinal, clastic deposits of the Road River Formation. Stratiform lead-zinc mineralization occurs at several horizons regionally within the Road River Formation, including just above the boundary at Howards Pass, to the northwest of the Avalanche Lake area. Detailed studies such as this refine the biostratigraphic zonation of the host rocks and assist regional understanding of the distribution and manner of emplacement of metallic mineralization in lower Paleozoic strata of Yukon Territory and southwestern District of Mackenzie.

Elkanah A. Babcock
Assistant Deputy Minister
Geological Survey of Canada

PRÉFACE

Le présent rapport se penche sur une faune d'Ostracodes silicifiés provenant de roches carbonatées de plate-forme faisant partie des formations de Whittaker et de Delorme, dans le bassin de Selwyn. Cette faune peut servir à délimiter la frontière entre l'Ordovicien et le Silurien dans la formation de Whittaker et à corréler les roches carbonatées de plate-forme aux dépôts clastiques de bassin contenus dans la formation de Road River. On note la présence, dans certaines régions, de minéralisations stratiformes de plomb et de zinc dans plusieurs horizons de la formation de Road River, notamment juste au-dessus de la frontière, dans le col Howards, au nord-ouest du lac Avalanche. La réalisation d'études détaillées de ce genre permet aux chercheurs d'établir la zonation biostratigraphique des roches encaissantes avec plus de précision tout en les aidant à mieux comprendre la répartition et le mécanisme de mise en place des minéralisations métalliques observées dans les strates du Paléozoïque inférieur, dans certaines régions du Yukon et du sud-ouest du district de Mackenzie.

Elkanah A. Babcock
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CONTENTS

1 Abstract/Résumé
2 Summary/Sommaire
3 Introduction
4 Previous work in the area
5 Acknowledgments
5 Stratigraphy and age
6 The ostracode fauna
6 Ordovician
10 Silurian
11 Ostracode biostratigraphy
12 Systematic paleontology
12 Ordovician
12 Genus *Parulrichia*
12 Genus *Bollia*
12 Genus *Aechmina*
13 Genus *Platybolbina*
13 Genus *Eurychilina*
14 Genus *Cystomatochilina*
14 Genus *Anticostiella*
14 Genus *Bromidella*
14 Genus *Lambeodella* n. gen.
15 Genus *Homeokiesowia*
15 Genus *Oepikella*
16 Genus *Leperditella*
16 Genus *Schmidtella*
16 Genus *Primitia*
16 Genus *Pheloparasclerites* n. gen.
17 Genus *Phelobythocyporis*
17 Genus *Krausella*
17 Genus *Steusloffina*
17 Silurian
17 Genus *Leptobolbina*
19 Genus *Apatobolbina*
19 Genus *Dolichoscapha*
20 Genus *Craspedobolbina*
20 Genus *Stroterobolbina*
21 Genus *Hyrsinobolbina*
21 Genus *Avalanchella* n. gen.
22 Genus *Camsella* n. gen.
22 Genus *Paranoviportia*
22 Genus *Gabrielsella* n. gen.
23 Genus *Nudista*
23 Genus *Cryptolopholobus*
23 Genus *Perrybolbina* n. gen.
24 Genus *Beyrichia*
25 Genus *Echinobeyrichia* n. gen.
26 Genus *Berdanopsis*
26 Genus *Cornikloedenina*
27 Genus *Pseudobeyrichia*
27 Genus *Welleriella*
27 Genus *Welleriopsis*
27 Genus *Bingeria*
28 Genus *Saccarchites*
28 Beyrichiacean indet. 1 to 4
29 Genus *Eoacantonodella* n. gen.
29 Genus *Kolmodinia*
29 Drepanellid indet. 1 to 2
29 Genus *Aechminaria*
30 Genus *Kirkbyella*
30 Genus *Abditoloculina*
30 Genus *Eurybolbina*
31 Genus *Triemilomatella*
31 Genus *Billingsopsis* n. gen.
31 Genus *Eoflaccivelum* n. gen.
32 Genus *Lomatobolbina*
32 Genus *Winchellatia*
33 Genus *Kiesowia*
33 Genus *Libumella*
34 Genus *Undulirete*

34 Genus *Venzavella*
35 Genus *Polenovula*
35 Genus *Limbinariopsis* n. gen.
35 Primitiopsid ? indet
35 Genus *Pribylites*
36 Genus *Primitiella*
36 Genus *Dizygopleura*
36 Genus *Rozhdestvenskayites*
37 Genus *Tipperopsis* n. gen.
37 Genus *Alaskabolbina*
38 Genus *Yukonibolbina*
38 Genus *Delormobolbina* n. gen.
39 Genus *Signetopsis*
39 Paleocopid indet. 1 to 3
39 Genus *Processobairdia*
40 Genus *Newsomites*
40 Genus *Spinobairdia*
40 Genus *Bairdiacypris*
40 Genus *Acanthoscapha*
41 Genus *Beecherella*
41 Genus *Shidelerites*
42 Genus *Berounella*
42 Genus *Tricornina*
42 Genus *Ovornina*
43 Genus *Ockerella*
43 Genus *Cooperatia*
43 Genus *Antijanusella*
43 Genus *Janusella*
44 Genus *Baschkirina*
44 Genus *Voronina*
44 Genus *Bairdiocypris*
44 Genus *Cadmea*
45 Genus *Longiscula*
45 Genus *Silenis*
45 Genus *Arcuaria*
46 Genus *Microchellinella*
46 Genus *Medianella*
46 Genus *Tubulibairdia*
46 Genus *Pseudorayella*
47 Genus *Steusloffina*
47 Genus *Spinosteusloffina* n. gen.
47 References
52 Appendices A-J
96 Index of fossils

Illustrations

Figures

3 1. Locality map.
4 2. Stratigraphic position of faunas from the Avalanche Lake sections.
6 3. Ordovician ostracodes, Section AV1.
7 4. Ordovician ostracodes, Section AV4B.
7 5. Silurian ostracodes, Section AV2.
8 6. Silurian ostracodes, Section AV1.
10 7. Silurian ostracodes, Section AV3.
10 8. Silurian ostracodes, Section AV4.
11 9. Stratigraphic distribution of selected beyrichiacean species.
12 10. Preliminary zonation of ostracodes.
15 11. Size dispersion, *Lambeodella uniloculata* n. sp.
18 12. Ventral cruminal morphology of Beyrichiacea.
42 13. *Shidelerites? laterospinosus* n. sp.

59-95 **Plates**
1-18.

SILICIFIED UPPER ORDOVICIAN – LOWER SILURIAN OSTRACODES FROM THE AVALANCHE LAKE AREA, SOUTHWESTERN DISTRICT OF MACKENZIE

Abstract

A silicified fauna occurs in Upper Ordovician – Lower Silurian platform sediments of the Whittaker and Delorme formations at Avalanche Lake, southwestern District of Mackenzie. The Ostracoda of this fauna can be used biostratigraphically to restrict the Ordovician – Silurian systemic boundary to a 23.5 m thick interval within the Whittaker Formation. A similar, though less complete, sequence of Ostracoda was previously recovered from deep water strata of the Road River Formation. Comparison of these faunas permits a tentative correlation between carbonate and clastic facies across widely separated areas of Selwyn Basin. Fourteen new genera (*Echinobeyrichia*, *Avalanchella*, *Camsella*, *Limbinariopsis*, *Gabrielsella*, *Perrybolbina*, *Delormobolbina*, *Eoacantonodella*, *Billingsopsis*, *Eoflaccivelum*, *Tipperopsis*, *Spinosteusloffina*, *Lambeodella*, and *Pheloparasclerites*) and 45 new species are described.

Résumé

On recontre une faune silicifée dans les sédiments de plate-forme d'âge Ordovicien supérieur à Silurien inférieur des formations de Whittaker et Delorme situées à Avalanche Lake dans le sud-ouest du district du Mackenzie. On peut employer des ostracodes faisant partie de cette faune, à des fins biostratigraphiques, pour limiter la frontière systémique entre l'Ordovicien et le Silurien à un intervalle d'une puissance de 23,5 m, à l'intérieur de la formation de Whittaker. On aviat autrefois trouvé une séquence similaire mais moins complète d'ostracodes dans des strates typiques d'eau profonde appartenant à la formation de Road River. En comparant ces faunes, on a pu établir de façon provisoire une corrélation entre des faciès des roches carbonatés et clastiques, de part et d'autre de régions largement éloignées du bassin de Selwyn. Dans cet article, on décrit quatorze nouveaux genres (*Echinobeyrichia*, *Avalanchella*, *Camsella*, *Limbinariopsis*, *Gabrielsella*, *Perrybolbina*, *Delormobolbina*, *Eoacantonodella*, *Billingsopsis*, *Eoflaccivelum*, *Tipperopsis*, *Spinosteusloffina*, *Lambeodella*, et *Pheloparasclerites*) et 45 nouvelles espèces.

Summary

Silicified Upper Ordovician – Lower Silurian ostracodes from five stratigraphic sections in the Mackenzie Mountains are described. These sections are situated along the slope-shelf boundary in the eastern Selwyn depositional basin about 10 km east of Avalanche Lake (lat. 62°23'N, long. 127°02'30"W), District of Mackenzie. Ostracode faunas, many prolific, were obtained from 79 stratigraphic levels within these sections; their description permits a more complete understanding of the Ordovician (Richmondian – Gamachian) to Silurian (Anticosti – Wenlock) ostracode sequence in the area.

The ostracodes are associated with trilobites, conodonts, bryozoans, brachiopods and graptolites, the faunal and stratigraphic relationships of which should provide a unique opportunity to review the mass extinction of many animal groups at the end of the Ordovician. Based on the evidence available so far, no diagnostic ostracode taxon crosses this systemic boundary, which is contained within a stratigraphic interval of 23.5 m (Avalanche Lake Section 1 = AV1-101 m to 124.5 m) from which no ostracode fauna has been recovered. Unlike the conformable Ordovician – Silurian sequence on Anticosti Island, Québec (where, based on ostracodes, the same systemic boundary is situated at the contact between rocks having the same lithology as the Ellis Bay and Becsie formations), the systemic boundary at Avalanche Lake is located within the Whittaker Formation and may only be determined biostratigraphically. It is not certain whether a hiatus exists at the boundary in this area, although elsewhere in the Yukon Territory – District of Mackenzie area it has been postulated that a hiatus exists.

Fourteen new genera (*Echinobeyrichia*, *Avalanchella*, *Camsella*, *Limbinariopsis*, *Gabrielsella*, *Perrybolbina*, *Delormobolbina*, *Eoacantonodella*, *Billingsopsis*, *Eoflaccivelum*, *Tipperopsis*, *Spinosteusloffina*, *Lambeodella*, and *Pheloparasclerites*) and 45 new species are described. In all, more than 120 taxonomic combinations (21 Ordovician, 102 Silurian) are reported. They range in age from Gamachian through Anticosti in the Whittaker Formation and, in the Delorme Formation, probably to late Wenlock. As the distinctive Ludlow ostracode, *Beyrichia* (*Beyrichia*) *henningsmoeni* McGill, was not found in the Avalanche Lake collections, it is not known if ostracodes of Ludlow age are present in the uppermost ostracode collections from Avalanche Lake Section 4 (AV 4), which are from the youngest strata investigated.

This report augments lower Paleozoic ostracode studies in the Yukon Territory – District of Mackenzie – State of Alaska area begun some two decades ago. These studies encompass ostracode faunas ranging in age from early Middle Ordovician to late Early Devonian. Much remains to be done before a truly comprehensive ostracode zonation is attempted, but at least some preliminary results are available for possible biostratigraphic use in an area where investigations of stratified base metal deposits are increasingly important.

Sommaire

Dans cet article, on décrit des ostracodes silicifiés d'âge Ordovicien supérieur à Silurien inférieur provenant de cinq coupes stratigraphiques des monts Mackenzie. Ces coupes sont situées le long de la limite entre le talus continental et la plate-forme continentale dans le bassin sédimentaire de l'est de Selwyn, à environ 10 km à l'est d'Avalanche Lake (lat. 62°23'N, long. 127°02'30"W), dans le district du Mackenzie. On a recueilli dans 79 niveaux stratigraphiques à l'intérieur de ces coupes, des faunes d'ostracodes souvent prolifiques; leur description permet de saisir de façon plus complète les séquences d'ostracodes de la région, de l'Ordovicien (Richmondien – Gamachien) au Silurien (Anticostien – Wenlockien).

Les ostracodes sont associés à des trilobites, conodontes, bryozoaires, brachiopodes et graptolites, dont les corrélations fauniques et stratigraphiques devraient nous offrir une occasion unique d'examiner l'extinction en masse de nombreux groups d'animaux à la fin de l'Ordovicien. Selon les indices que l'on a obtenus jusqu'à présent, aucun taxon diagnostique d'ostracodes ne traverse cette frontière systémique, qui est contenue à l'intérieur d'un intervalle stratigraphique de 23,5 m (coupe 1 d'Avalanche Lake = AV1-101 m à 124,5 m) dont on n'a extrait aucune faune d'ostracodes. Contrairement à la séquence concordante ordovicienne-silurienne rencontrée sur l'île d'Anticosti au Québec (où, d'après les ostracodes présents, la même limite systémique existe au contact de roches de même caractère lithologique que les formations d'Ellis Bay et de Becsie), la frontière systémique, dans la coupe d'Avalanche Lake, se situe à l'intérieur de la formation de Whittaker et ne peut être déterminé que par étude biostratigraphique. On ne sait pas si dans ce secteur, apparaît une lacune au niveau de cette frontière systémique, bien qu'ailleurs dans la région du territoire du Yukon et du district du Mackenzie, on admette qu'il existe une telle lacune.

Dans cet article, on décrit quatorze nouveaux genres (*Echinobeyrichia*, *Avalanchella*, *Camsella*, *Limbinariopsis*, *Gabrielsella*, *Perrybolbina*, *Delormobolbina*, *Eoacantonodella*, *Billingsopsis*, *Eoflaccivelum*, *Tipperopsis*, *Spinosteusloffina*, *Lambeodella* et *Pheloparasclerites*) et 45 nouvelles espèces. En tout, on donne plus de 120 combinaisons taxonomiques (21 pour l'Ordovicien, 102 pour le Silurien). Dans la formation de Whittaker, leur âge se situe entre le Gamachien et l'Anticostien inclus et dans la formation de Delorme, entre le Gamachien et (probablement) le Wenlockien supérieur. Étant donné que l'on n'a pas trouvé dans les collections d'ostracodes provenant d'Avalanche Lake l'ostracode distinctif du Ludlovien, *Beyrichia* (*Beyrichia*) *henningsmoeni* McGill, on ne peut dire s'il existe des ostracodes d'âge Ludlovien dans les collections d'ostracodes recueillies au sommet de la coupe 4 d'Avalanche Lake (AV 4), qui proviennent des strates les plus récentes explorées.

Le présent rapport complète les études sur les ostracodes du Paléozoïque inférieur, que l'on avait enterprises il y a environ deux décennies au Yukon, dans le district du Mackenzie et en Alaska. Ces études portent sur toutes les faunces d'ostracodes dont l'âge est compris entre le début de l'Ordovicien moyen et la fin du Dévonien inférieur. Il reste beaucoup à faire avant de pouvoir commencer à établir une zonation vraiment complète des ostracodes, mais l'on dispose au moins de quelques résultats préliminaires qui pourraient avoir une importance biostratigraphique dans une région où l'exploration des gîtes stratifiés métalliques communs joue un rôle de plus en plus important.

INTRODUCTION

During the past twenty years, knowledge of pre-Middle Devonian Ostracoda from northwestern North America has increased greatly. The first published records were by McGill (1963) and Copeland (1966), describing some Silurian species from Yukon Territory. Later, Berdan and Copeland (1973) described Lower Devonian ostracodes, and Copeland (1974a, b; 1976; 1977; 1978a, b; 1982a, b) reported on Middle to lower(?) Upper Ordovician and Middle Silurian to Lower Devonian ostracodes from the State of Alaska, Yukon Territory and southwestern District of Mackenzie. Ostracodes from the missing faunal interval, from uppermost Ordovician to lower Middle Silurian, have now been recognized, and faunas from the Avalanche Lake sections of District of Mackenzie are described that bridge most of this gap.

Ostracode faunas collected by B.S. Norford and A.W. Norris of the Geological Survey of Canada during the 1960s are mostly calcareous, but later collections, processed with acid for trilobite, conodont, brachiopod and other remains, are silicified, and numerous well preserved ostracode faunas have been found. Collections from the State of Alaska (in Berdan and Copeland, 1973) were prepared by members of the United States Geological Survey, those from northwestern Canada were obtained through the courtesy of A.C. Lenz (University of Western Ontario), B.D.E. Chatterton (University of Alberta), R. Ludvigsen (University of Toronto), and D.G. Perry (University of British Columbia). Over the years these workers have submitted to the author numerous collections of well preserved ostracodes, both "picked" and put into microfossil slides, and in residues, which have not all been examined in their entirety.

The new collections on which the present study is based were submitted by B.D.E. Chatterton. They are from four nearly contiguous stratigraphic sections of the Whittaker and Delorme formations sampled by Chatterton and Perry during 1978 and 1979, about 10 km east of Avalanche Lake, Mackenzie Mountains, District of Mackenzie (lat. 62°23'N; long. 127°02'30"W). The locations of these sections are indicated (Fig. 1) by Johnston and Chatterton (1983, p. 845, Fig. 1) as AV1, AV2, AV3 and AV4 and Nowlan et al. (1988, Figs. 1, 2). This locality nomenclature will be followed in the present report, succeeded by a number (metres above the base of the measured section, similar for both 1978 and 1979) and occasionally by the letter T, indicating a talus collection. The lithological columns are shown in Johnston and Chatterton (1983, p. 846, Fig. 2) and the lower portions of Sections AV1 and AV4B are shown by Nowlan et al. (1988, Fig. 3). Additional collections were made by Chatterton and D.J. Over in 1983 from near the Ordovician-Silurian transition beds subjacent to Section AV4 – those collections, from the Whittaker Formation, are labelled AV4B with stratigraphic thickness measurements independent of the younger Section AV4. In all, ostracode collections from 79 stratigraphic levels were studied (32 from Section AV1, 12 from Section AV2, 4 from Section AV3, 20 from Section AV4 and 11 from Section AV4B). Eighty-six ostracode genera (14 new) comprising 122 taxonomic combinations (45 new) are reported. It is considered that most, if not all, of the palaeocopid genera present are recorded here but probably some of the podocopid genera have been overlooked, mainly because of the great similarity of many podocopid valves and the lack, in many cases, of carapaces that would reveal overlap features necessary to determine generic characteristics.

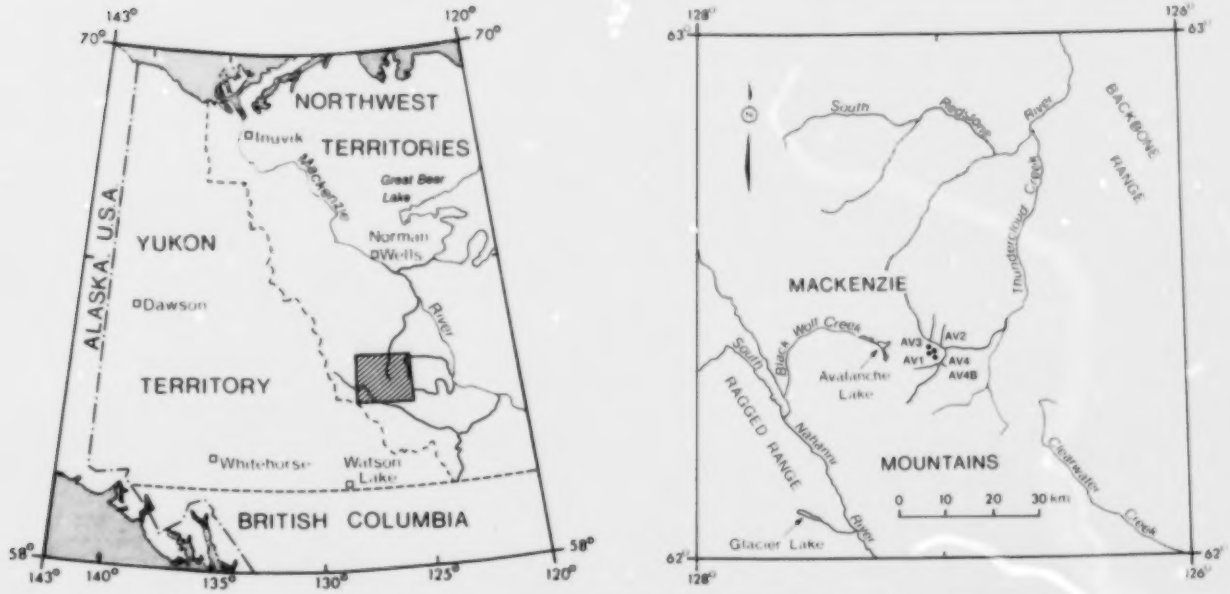


Figure 1. *Locality map (from Nowlan et al., 1988) showing sections AV1, AV2, AV3 and AV4.*

Previous work in the area

Several papers have been published that deal with the stratigraphy and/or paleontology of that part of the Avalanche Lake area dealt with here (Fig. 2). Gabrielse et al. (1973), as part of "Operation Nahanni", described the geology of the Glacier Lake map area, which includes the Avalanche Lake region, and, in Part II of their memoir, published the description of a stratigraphic section (no. 44, p. 242) 3035 m thick at latitude 62°25'N and longitude 127°09'W. Some Silurian megafossils were recorded from the Whittaker Formation portion (250-1025 m) of that section. Lenz (1977, locality 2, p. 1524) reported on silicified brachiopods of two collections from a section at latitude 64°23'N and longitude 127°03'W. Ostracode faunas from Lenz's collection were described by Copeland (1978a). Lenz's locality 2 is herein recorded as within Chatterton and Perry's Section AV4, and faunas from the two collections reported on independently by Lenz and Copeland from the Road River Formation (herein the Delorme Formation) are approximately equivalent to collections AV4-126-128 m (Lenz's locality 675-685 ft.) of the present publication [This correlation of the Lenz (1977) and Chatterton and Perry (1983) localities at Section AV4 is in agreement with Chatterton's present interpretation (pers. comm., 1984)]. Lenz tentatively considered those collections as early Wenlock in age because of the presence of specimens of the brachiopod genera *Atrypella* and *Janius*, and Chatterton and Perry (in Lenz, 1977, p. 1524; 1983, p. 4) reaffirmed this age designation for Lenz's stratigraphically lower locality (675-685 ft.; 206-209 m) on the basis of trilobites and conodonts, assigning it to the *Pterospathodus amorphognathoides* Zone. Ludvigsen (1979) described Middle to lower(?) Upper Ordovician trilobite faunas from this general area. His *Whittakerites planatus* assemblage zone of Eden and younger(?) Ordovician age contains representatives of the oldest ostracode assemblage described herein (see Copeland, 1977, p. 3). Jackson and Etherington (1969) and Lenz and McCracken (1982) reported on Lower Silurian graptolites from a section

SERIES	STAGE	FORMATION	OSTRACODA	TRILOBITA	BRYOZOA BRACHIOPODA	ROSTROCONCHA	CONODONTA
			This paper	Chatterton and Perry (1983, 1984) (very generalized)	Bolton and Ross (1985); Lenz (1977)	Johnson and Chatterton (1983)	Chatterton and Perry (1983)
LOWER SILURIAN	WENLOCKIAN	DELORME	*Beyrichia (B.) lenzi* *Avalanchella* *Echinobeyrichia* *Billingsopsis* *Gabrielsella*	k. *Diacanthaspis* j. *Acidaspis*	*Atrypella* *Janius*	*Nehedia grovesi* *Bigalea* *Nehedia bainsi*	5. *Ozarkodina saggita bohemica* 4. *Kockelella walliseri* 3. *Pterospathodus amorphognathoides*
	ANTICOSTIAN	WHITTAKER	*Beyrichia (B.) keslingi* *Craspedobolbina (Mitrobeyrichia)* *Leptobolbina?* sp.	i. *Ceratocephala* h. *Youngia* g. *Ceratocephalina* f. *Leonaspis* e. *Odontopleura* d. *Acidaspis* c. *Stelkaspis* b. *Primaspis*		*Malciodens* *Bransonia*	2. *Pterospathodus celloni*
UPPER ORDOVICIAN	GAMACHIAN		?	?	?	?	?
	RICHMONDIAN		*Platybolbina (Reticulobolbina) lenzi* *Steusloffina* sp. cf. *S. cuneata*	a. *Ceratocephala* (*Whittakerites planatus*)	*Sceptropora*		1. *Distomodus kentuckyensis*

Figure 2. *Stratigraphic position of faunas described from the Avalanche Lake sections. The position of the Ordovician-Silurian boundary is predicted from the Ordovician age of the* ***Platybolbina (Reticulobolbina) lenzi*** *ostracode fauna.*

at Clearwater Creek (lat. 61°35'N; long. 125°35'W), and Lenz (1982) described fauna of similar age from several additional sections. Johnston and Chatterton (1983) reported on new, silicified rostroconchs from each of the Avalanche Lake sections collected in 1978 and 1979. Those specimens range in age from late Anticosti (Whittaker Formation, Sections AV2 and AV3) to late Wenlock-early Ludlow? (Delorme Formation, Sections AV1 and AV4). Odontopleurid and cheirurid trilobites from the Silurian part of these sections were described by Chatterton and Perry (1983, 1984), Upper Ordovician sceptroporid bryozoans were recently described by Bolton and Ross (1985), Upper Ordovician conodont faunas by Nowlan et al. (1988), and Lower Silurian faunas by Over and Chatterton (1987).

Acknowledgments

The author is indebted to B.D.E. Chatterton for permission to study and describe the Avalanche Lake ostracode fauna from his collections. Chatterton, the late D.G. Perry, and students from the University of Alberta measured the four initial Avalanche Lake sections during the summers of 1978 and 1979 (Section AV4B was measured by Chatterton and Over in 1983). Their stratigraphically arranged collections were prepared for trilobite, conodont and other studies and many of the ostracode collections were "picked" in their laboratory. The author expresses his indebtedness to these workers for their meticulous labour on his behalf. The bulk acid residues were "picked" for Ostracoda by D. Nowlan. SEM photomicroscopy was by D.A. Walker (Geological Survey of Canada) using an Etec Autoscan microscope, and by the author using a Cambridge Stereoscan 180 microscope; the resulting plates were produced in the Photography Section of the Geological Survey of Canada under the direction of J.W. Kempt.

During the study, the author was assisted on numerous occasions by J.M. Berdan, United States Geological Survey. Her advice on taxonomic problems and her critical review of the manuscript are greatly appreciated. R.V. Kesling (University of Michigan) was most helpful in supplying information pertinent to the morphology of the Beyrichiacea, in particular that of *Treposella lyoni* (Ulrich).

STRATIGRAPHY AND AGE

The Avalanche Lake sections discussed here occur on the northeast flank of the Avalanche Syncline (Gabrielse et al., 1973). Three Ordovician and/or Silurian formations are recognized in the area – the carbonate rich, platformal Whittaker and overlying Delorme formations and their lateral facies equivalent, the shaly, presumably basinal, Road River Group. Chatterton and Perry (1983, 1984) recognized only the Whittaker and Delorme formations in the Avalanche Lake sections although Lenz (1977) considered the brachiopod-rich shaly interval between these carbonates (in Chatterton and Perry's Section AV4) to be of Road River facies. This latter interpretation was followed by Copeland (1978a). It now seems expedient to accept the interpretation advanced by Chatterton and Perry in order to avoid nomenclatural difficulties, but also to acknowledge that "shales that could be assigned to the Road River Formation occur in the lower part of the interval assigned to the Delorme Formation" (Chatterton and Perry, 1983, p. 3). For a full discussion of the stratigraphy refer to Chatterton and Perry (1983); a general discussion is contained in Chatterton and Ludvigsen (1983).

The Whittaker Formation crosses the boundary between the Upper Ordovician and Lower Silurian in two sections discussed here, AV1 and combined, discontinuous AV4B and AV4, and ranges upward approximately to the base of the Wenlock. No graptolite zonation has been established in these sections, but Chatterton and Perry (1983) defined the base of the Silurian either as the base of their odontopleurid faunal assemblage "a" at locality AV1-84.5 m, or at the occurrence of the conodont *Distomodus kentuckyensis* at locality AV1-95.5 m. It is possible that a hiatus exists within the Whittaker Formation near this approximately 14 m thick interval (locality AV1-84.5 m to locality AV1-98.5 m) or, based on ostracode occurrences, at or above locality AV1-99 m (see below). Such a hiatus has been suggested by Lenz (1976) and Lenz and McCracken (1982) to exist between the Ordovician and Silurian portions of the Whittaker Formation elsewhere in Yukon Territory and District of Mackenzie. Certainly the quality of preservation of the ostracodes within this general interval deteriorates markedly, and the relative size of individuals is much diminished, compared with those in adjacent strata. Whether this is caused by imperfect silicification of the specimens and/or the result of ecological conditions induced either by the Gamachian glacial(?) episode or "from metalliferous fluids discharged into local basins generated by comtemporaneous (sic) block faulting" (Goodfellow and Jonasson, 1984) is conjectural. Only samples from localities between 62 m and 136.5 m in Section AV4B have been studied; the ostracode faunas from part of that interval are likewise relatively poorly preserved and mostly "dwarfed".

Ostracodes were not recovered from Section AV1 from localities between 101 m and 124.5 m and were not available in Section AV4B above locality 136.5 m. Ostracode faunas from localities AV1-99 m, AV4B-136.5 m and stratigraphically older localities have a generic composition (tetradellid-aechminid-platybolbinid) of Upper Ordovician (Cincinnati) aspect. The fauna from locality AV1-124.5 m contains beyrichiacean ostracodes and is of Early Silurian (Anticosti) aspect.

Disagreement between the positioning of the Ordovician-Silurian boundary in Canada based on ostracode and conodont faunas was first revealed after studies on Anticosti Island, Québec. There, the base of the Silurian *Oulodus? nathani* conodont zone was placed at the top of the biohermal concentration in the upper Ellis Bay Formation (Barnes and McCracken, 1981; Nowlan, 1982). However, on Anticosti Island the known upper limit of the occurrence of the Upper Ordovician (Gamachian) zone ostracode *Euprimitia gamachei* Copeland is at least 1 m higher (Nowlan, 1982), the Upper Ordovician ostracode *Steusloffina cuneata* (Steusloff) is 6 m higher (Copeland, 1983) and a tetradellid species is located some 25 m higher (Copeland, 1974) than the coral reef horizon at Fox Bay, Cape Henry, and Salmon River, respectively. At Avalanche Lake a similar discrepancy occurs. The conodont *Distomodus kentuckyensis* first occurs at locality AV1-95.5 m within odontopleurid trilobite faunal assemblage "a" of Chatterton and Perry (1983, Textfig. 3, p. 5) although in Textfigure 1 (p. 4) they indicate that all of odontopleurid faunal assemblage "a" (localities AV1-84.5 m to AV1-97.5 m) is Silurian. Nowlan et al. (1988) consider that the highest unequivocal Ordovician conodont assemblage occurs at AV4B-111 m. In contrast, the ostracodes in Section AV1 indicate the known upper limit of the Ordovician *Platybolbina* (*Reticulobolbina*) *lenzi* ostracode assemblage to be at locality AV1-99 m, or from 3.5 m above the first occurrence of *D. kentuckyensis* to 14.5 m above the initiation of odontopleurid assemblage "a", and at AV4B-136.5 m.

The reasons for the variation in time of faunal change-over between these two microfossil groups is conjectural, but in both documented occurrences (Anticosti Island and Avalanche Lake) studied by the author, ostracode faunas of Ordovician aspect continue higher in the stratigraphic column than conodont faunas assigned to the Ordovician (Nowlan et al., 1988). Greater tolerance to ecological variation by ostracode populations may be part of the answer, but man-made systemic boundaries may be another. In the former case, Goodfellow and Jonasson (1984, p. 583) have shown that "^{34}S values in pyrite increase stratigraphically upward throughout most of the Ordovician reaching an average of +14.6°/₀₀ during Late Ordovician to Early Silurian . . . , indicating that the Selwyn Basin was at least partially restricted and perhaps was becoming increasingly isolated from open ocean water at this time." In the latter case it may be prudent to consider the Ordovician-Silurian boundary (Gamache-Anticosti) as a time of faunal transition and of varying duration, depending on the faunal group being considered. In this paper the change-over of the ostracode assemblages from that of Ordovician to Silurian aspect occurs within the Whittaker Formation at or above localities AV1-99 m and AV4B-136.5 m, but below locality AV1-124.5 m. This faunal change cannot be more closely documented because of the lack of information on intermediate ostracode faunas.

The upper limit of the Whittaker Formation is placed at the base of the approximately 90 to 130 m calcareous shale unit in the lower part of the Delorme Formation (initiation of grand cycle three of Chatterton and Perry, 1983, at localities AV1-460 m, AV2-152 m, AV3-155 m, AV4-O m and the approximate, lowest occurrence of the Llandovery-Wenlock transition biozone of the conodont *Pterospathodus amorphognathoides*). It was from this calcareous shale unit that Lenz (1977) reported 29 brachiopod genera and Copeland (1978a) reported 20 ostracode genera from a section at 300 to 330 ft. (herein locality AV4-126-128 m). Chatterton and Perry (1983) recorded a specimen of the lower Wenlock conodont *Kockelella walliseri* from slightly younger strata at locality AV2-242 m. They concluded that "The lower part of the Delorme Formation in the Avalanche Lake area is lower Wenlock." (Chatterton and Perry, 1983, p. 4).

The calcareous upper unit of the Delorme Formation in the Avalanche Lake sections is considered as late Wenlock in age, but may be as young as early Ludlow. Chatterton and Perry (1983) recorded the late Wenlock conodont *Ozarkodina sagitta bohemica* from locality AV4-165 m. They conclude that their highest odontopleurid trilobite-bearing horizons (fauna "k" from localities AV4-165 m to AV4-248 m) "are, at oldest, late Wenlock in age; and are probably early Ludlow in age" (1983, p. 4).

THE OSTRACODE FAUNA

Ordovician

The Whittaker Formation in two of the Avalanche Lake sections (AV1 and AV4B) contains ostracodes of Ordovician age (Figs. 3, 4). These correlate with an isolated ostracode fauna from Road River Formation strata at Blackwolf Mountain (lat. 62°22'N; long. 127°31'W), about 20 km southwest of the Avalanche Lake sections, collected by Ludvigsen (Ludvigsen, 1975, p. 691) and described by Copeland (1977). At that time, the late Ordovician *Platybolbina* (*Reticulobolbina*) *lenzi* ostracode assemblage was biostratigraphically equated (Ludvigsen, 1975, p. 681; 1979) with the Edenian-Maysvillian interval and placed within the *Cryptolithus-Anataphrus/Bighornia-Thaerodonta* fauna. Tipnis et al. (1978) equated this Blackwolf Mountain assemblage with conodont Fauna 10 or younger. The presence of *P.* (*R.*) *lenzi* at localities AV1-86 m to AV1-99 m and localities AV4B-112 m to AV4B-136.5 m indicates that this species ranges to (or near) the Ordovician-Silurian boundary, based on ostracodes. It appears, therefore, that the *P.* (*R.*) *lenzi* assemblage could be equivalent in age to conodont Fauna 10?, or younger, and range from Maysvillian to Richmondian or Gamachian. Such an extended range is considered unlikely and, because of better dating in the Avalanche Lake sections, the *P.* (*R.*) *lenzi* assemblage is considered as Richmondian-Gamachian?, and therefore younger than previously assumed. Typical of this *P.* (*R.*) *lenzi* fauna in the Avalanche Lake sections are *P.* (*R.*) *lenzi*, *Steusloffina* sp. cf. *S. cuneata* (Steusloff), *Aechmina wolfensis* Copeland, *Aechmina* spp., *Bromidella obesa* n. sp., *Homeokiesowia* sp., *Oepikella* sp., *Krausella* spp., *Anticostiella reticulata* n. sp. and *Lambeodella uniloculata* n. gen., n. sp., among others. None of these species is present in younger strata of Avalanche Lake Section AV1. The recovery of hollinaceans (Hollinidae, Eurychilinidae, Tetradellidae) in these Upper Ordovician strata reinforces the observation (Copeland, 1981) based on a study of faunas

SPECIES	WHITTAKER FORMATION												
	Position above base of section (in metres)												
	20	33.5	41	46	53.5	54	76.5	86	89	92	95.5	99	101
PALAEOCOPIDA													
DREPANELLACEA													
Parulrichia? sp.													
Bollia sp.													
Aechmina wolfensis Copeland					•	•				•	•		
Aechmina overi n. sp.					•	•							
Aechmina spp.				•	•	•				•	•		
HOLLINACEA													
Platybolbina (*Reticulobolbina*) *lenzi* Copeland								•	•	•	•	•	
Eurychilina? sp. indet. 1					•	•							
Cystomatochilina sp.					•								
Bromidella obesa n. sp.					•	•							
Anticostiella reticulata n. sp.					•	•							
Lambeodella uniloculata n. sp.				•	•	•							
Homeokiesowia sp.					•	•							
Oepikella sp.					•	•							
LEPERDITELLACEA													
Leperditella sp. cf. *L. globosa* Sarv					•	•				•	•		
Schmidtella? sp.					•	•		•					
Primitia? sp.		•			•								
PODOCOPIDA													
HEALDIACEA													
Pheloparasclerites berdanae n. sp.													
Phelobythocypris cylindrica (Hall)					•	•	•	•	•	•	•	•	
Phelobythocypris sp.	•		•				•						?
Krausella spp.					•	•	?				•		
Family unknown													
Steusloffina sp. cf. *S. cuneata* (Steusloff)											•		

Figure 3. *Distribution of Ordovician ostracodes, Whittaker Formation, Section AV1.*

of similar age from Anticosti Island, Québec, that the Ordovician (Richmondian-Gamachian?)-Silurian (Anticosti) boundary may be determined by the disappearance of typically Ordovician hollinacean genera at the end of the Ordovician and the first appearance of beyrichiacean genera in the early Silurian. In Section AV1, an interval of 25.5 m occurs between known occurrences of these two ostracode faunas (from localities AV1-99 m to AV1-124.5 m) and it is presently not possible to define the systemic boundary more precisely.

Correlation between the Ordovician fauna of Avalanche Lake Sections AV1 and AV4B is readily apparent (Figs. 3, 4). The composition of the ostracode fauna from localities AV1-53.5 m to AV1-54 m is very similar to that from locality AV4B-80.25 m. Also, the ostracode faunas from localities AV1-86 m to AV1-99 m equate well with those from localities AV4B-112 m to AV4B-136.5 m.

SPECIES	WHITTAKER FORMATION Position above base of section (in metres)										
	80.25	94.5	107.4	111	111.5	111.6	112	120	121	128.5	136.5
PALAEOCOPIDA											
DREPANELLACEA											
Parulrichia? sp.				•							
Bollia sp.							•				
Aechmina wolfensis Copeland	•		•				•				
Aechmina overi n. sp.											
Aechmina spp.	•						•				
HOLLINACEA											
Platybolbina (*Reticulobolbina*) *lenzi* Copeland							•	•	•	•	•
Eurychilina? sp. indet. 1	•										
Cystomatochilina sp.											
Bromidella obesa n. sp.											
Anticostiella reticulata n. sp.	•										
Lambeodella uniloculata n. sp.	•										
Homeokiesowia sp.											
Oepikella sp.											
LEPERDITELLACEA											
Leperditella sp. cf. *L. globosa* Sarv	•										
Schmidtella? sp.						•					
Primitia? sp.											
PODOCOPIDA											
HEALDIACEA											
Pheloparasclerites berdanae n. sp.					•						
Phelobythocypris cylindrica (Hall)	•		•						•	•	
Phelobythocypris sp.		•		•	•	•	•	•		•	•
Krausella spp.	•							?			
Family unknown											
Steusloffina sp. cf. *S. cuneata* (Steusloff)					•	•					

Figure 4. *Distribution of Ordovician ostracodes, Whittaker Formation, Section AV4B.*

SERIES	ANTICOSTIAN						WENLOCKIAN				
FORMATION	WHITTAKER						DELORME				
SPECIES	Position above base of section (in metres)										
	9	11.5	15T	47	152	157	242	255-260	256	262	274-279
Drepanellid indet. 1	•		•								
Janusella? *latispinosa*		•									
Leptobolbina? sp. 2		•		•							
Saccarchites? sp.		•									
Tipperopsis quadrilineata		•									
Cooperatia lacrimosa		•		•							
Arcuaria avalanchensis		•									
?*Yukonibolbina* sp. 2				•							
Libumella cardinalis				•	•					•	
Bairdiacypris sp.											
Arcuaria delormensis					•		•	•			•
Perrybolbina bicuspidata						•			•		•
Libumella sp. cf. *L. ambigua*						•	•	•	•	•	•
"*Rozhdestvenskayites*" sp.						•					
Tubulibairdia sp.						•	•		•	•	•
Paranoviportia? sp.						•					
Undulirete mackenziensis						•			•	•	•
Dolichoscapha minuta						•					
Apatobolbina elongidolonata						•					
Microcheilinella spp.						•	•				
Silenis proteus						•	•	•	•		
Bairdiocypris longus						•					
"*Acanthoscapha*" *dorsiglobosa*						•					
Libumella marginata						•					
Triemilomatella? sp.							•				
Echinobeyrichia spinosa							•	•	•	•	•
Kiesowia? *decinodosa*							•	•	•		
Avalanchella bicristata							•	•	•	•	
Gabrielsella reticulata							•	•	•		•
Beyrichia (*Beyrichia*) *lenzi*							•	•	•	•	•
Pseudobeyrichia cristata							•		•		•
Billingsopsis planivelata							•		•		•
Eoflaccivelum blussoni							•	•	•		•
Bairdiacypris? *subarctica*							•		•		
Abditoloculina triloculata							•	•			•
Alaskabolbina trinodosa							•	•			•
Ockerella jordani							•	•	•	•	•
Baschkirina? sp.							•	•	•		•
Cadmea acuta							•	•			•
Acanthoscapha subnavicula							•	•	•		•
Longiscula sp.							•	•	•		
Newsomites inequalis							•				
Processobairdia delormensis							•	•	•	•	•
Spinobairdia dorsicornis							•	•	•	•	•
Tricornina (*Tricornina*) *navicula*							•	•	•	•	•
Kolmodinia martinssoni								•			
Stroterobolbina? sp.									•		
Nudista sp.									•		
Antijanusella spinosa									•		
Bairdiocypris sp.									•		
Lomatobolbina? sp.									•		
Welleriopis? sp.									•		
Microcheilinella spp.									•	•	•
Avalanchella bicristata micropunctata										•	•
Berdanopsis? *planus*											•
Beecherella rhomboidalis											•
Signetopsis reticulata											•
Libumella sp. 1											•
Yukonibolbina? sp. 1											•

Figure 5. *Occurrence of Silurian ostracodes, Avalanche Lake, Section 2 (AV2). T = talus.*

SERIES	ANTICOSTIAN														WENLOCKIAN											
FORMATION	WHITTAKER														DELORME											
SPECIES	Position above base of section (in metres)																									
	124.5	320	320T	336	336T	341	346	413	414	418T	421	460	583.5	586	586.1	589.8	590	592	595	599	630					
Leptobolbina? sp. 2	•																									
Craspedobolbina? sp.	•																									
Saccarchites? sp.	•																									
Eurybolbina sp.	•																									
Libumella sp. indet.	•																									
Undulirete? sp.	•																									
Pribylites? sp.	•																									
Primitiella sp. 2	•																									
Arcuaria sp. cf. A. sinectivula	•		•	•	•	•	•	•	•																	
Beynichia (Beynichia) keslingi			•	•	•	•	•	•	•																	
Cooperatia lacrimosa		•											•			•	•									
Abditoloculina? sp.		•																								
Steusloffina? symmetrica		•				•					•															
Craspedobolbina (Mitrobeynichia) siveteri			•	•	•	•	•			•																
Libumella sp. cf. L. ambigua			•	•	•	•	•			•		•	•				•	•	•	•						
Arcuaria avalanchensis			•	•			•	•					•	•	•	•	•	•	•							
Silenis mawii			•	•	•		•	•		•	•															
Craspedobolbina (Mitrobeynichia) lundini					•		•					•														
Beyrichiacean indet. 1				•																						
Abditoloculina sp. cf. A. trioculata					•		•			•																
Tipperopsis quadriimeata					•																					
Leptobolbina? sp. 1						•																				
Apatobolbina? sp.						•																				
Antijanusella spicata						•																				
Silenis symmetricus						•																				
Tubulibairdia sp.						•	•			•																
Leptobolbina plana						•	•	•		•																
Voronina? sp.						•		•		•																
Yukonibolbina sp.						•																				
Antijanusella spinosa							•	•					•	•	•	•	•	•	•							
Ockerella jordani							•	•																		
Libumella? cardinalis							•						•	•	•	•	•	•	•							
Medianella? sp.							•																			
Beecherella roddicki																										
Baschkirina? sp.							•			•			•													
Drepanellid indet. 2														•	•	•	•	•								
Acanthoscapha subnavicula										•																
Longiscula? sp.												•	•	•	•											
Newsomites inequalis												•	•		•											
Cadmea acuta												•	•				•	•								

Figure 6. *Occurrence of Silurian ostracodes, Avalanche Lake, Section 1 (AV1). T = talus.*

Bairdiacypris subarctica
Avalanchella bicristata
Camsella nodosa
Beyrichia (Beyrichia) lenzi
Cornikloedenina tuberculata
Aechminaria equalis
Kirkbyella (Berdanella) belli
Winchellatia? sp.
Venzavella? sp.
Polenovula rara
Limbinariopsis sinuata
Primitiella sp. 1
Alaskabolbina trinodosa
Ovornina (Tricornella) perryi
Echinobeyrichia spinosa
Gabrielsella reticulata
Beyrichiacean indet. 3
Processobairdia delormensis
Spinobairdia dorsicornis
Acanthoscapha sp. cf.
A. decurtata
Tricornina (Tricornina) navicula
Arcuaria delormensis
Billingsopsis planivelata
Pseudobeyrichia cristata
Rozhdestvenskayites? sp.
Undulirete mackenziensis
Silenis proteus
Ovornina (Ovornina) sp.
Eoflaccivelum blussoni
Libumella sp. cf. L. circulata
Bairdiacypris? sp.
Ovornina? sp.
Winchellatia berdanae
Abditoloculina triloculata
Avalanchella
bicristata micropunctata
Nudista sp.
Wellerielle? sp.
Berdanopsis ursensis
Berdanopsis royalensis
Berdanopsis? plana
Cryptolopholubus sp.
Beyrichia
(Simplicibeyrichia) sp. 2
Berounella spicata
"Acanthoscapha" dorsiglobosa
Alaskabolbina? sp.

Silurian

If there is a chronostratigraphic break between ostracode faunas of Ordovician and Silurian aspect from localities AV1-99 m and AV1-124.5 m it has not been detected. Chatterton and Perry (1983, Textfig. 3) include both localities within the *Distomodus kentuckyensis* conodont zone, but no conodonts are reported from locality AV1-124.5 m. The next higher conodont occurrence is at locality AV1-320 m where *Pterospathodus celloni* occurs. Within the 221 m of section between these occurrences Chatterton and Perry (*ibid.*, Textfig. 4) report one odontopleurid trilobite occurrence, *Stelckaspis sinedentata*, at locality AV1-124.5 m, and assign that occurrence to their odontopleurid trilobite assemblage "c".

The age of the ostracode fauna at locality AV1-124.5 m (Fig. 4) cannot be determined with certainty within the Anticosti. It contains several beyrichiacean genera (see appendices) that occur with lower Llandovery faunas of the Baltic region. The first occurrence of *Beyrichia (Beyrichia) keslingi* n. sp. at locality AV1-320 m appears to agree with the early occurrences of species of this genus elsewhere in the northern hemisphere and may be considered as relatively late Anticosti (Telychian = Llandovery C5 - early C6) in age. This species occurs as high as locality AV1-414 m (Fig. 9).

SERIES	ANTICOSTIAN		WEN-LOCKIAN	
FORMATION	WHITTAKER		DELORME	
SPECIES	Position above base of section (in metres)			
	1	5	60	155
Silenis mawii	•	•	•	
Abditoloculina triloculata		•	•	
Leptobolbina? sp. 2		•		
Tricornina (Tricornina) navicula		•		
Ockerella jordani		•	•	
Janusella? *latispinosa*		•		
Ockerella longula		•		
Shidelerites? *laterospinosus*		•		
Beecherella roddicki		•	•	
"*Rozhdestvensi nyites*" sp.cf. "*R.*" *auriculiferus*		•		
Palaeocopid indet. 2		•		
Yukonibolbina sp.		•		
cf. *Ortygia* sp.		•		
Leptobolbina plana		•		
Perrybolbina bicuspidata			•	•
Cooperatia lacrimosa			•	
Libumella sp. cf. *L. ambigua*			•	
Steusloffina symmetrica			•	
Apatobolbina elongidolonata			•	•
Beyrichia (Beyrichia) keslingi			•	
Baschkirina? sp.			•	
Pseudorayella? sp.			•	
Cadmea inexplorata			•	
Primitiopsid? indet.			•	
Gabrielsella reticulata				•
Berdanopsis royalensis				•
Eoflaccivelum blussoni				•
Beyrichiacean indet. 2				•
Berdanopsis sp. cf. *B. ursensis*				•
Beyrichia (Beyrichia) lenzi				•

Figure 7. *Occurrence of Silurian ostracodes, Avalanche Lake, Section 3 (AV3).*

The most prolific Silurian ostracode fauna occurs from locality AV1-583.5 m to locality AV1-599 m (Fig. 6), locality AV2-242 m to locality AV2-274-279 m (Fig. 5) locality AV3-60 m (Fig. 7) and locality AV4-126T m (Fig. 8) with odontopleurid trilobite fauna "j" and is considered as early Wenlock in age. This *Beyrichia (Beyrichia) lenzi* fauna

SERIES	WENLOCKIAN					
FORMATION	DELORME					
SPECIES	Position above base of section (in metres)					
	107	126T	136T	165T	166T	240
Apatobolbina? sp.	•					
Beyrichia (Beyrichia) lenzi	•					
Cornikloedenina tuberculata	•	•				
Spinobairdia dorsicornis	•					
Acanthoscapha sp. cf. *A. decurtata*	•					
Berounella spicata	•					
Tricornina (Tricornina) navicula	•					
Ovornina (Tricornella) perryi	•					
Ockerella jordani	•					
"*Beecherella*" sp.	•					
Avalanchella bicristata		•	•			
Camsella nodosa		•				
Gabrielsella reticulata		•				
Nudista sp.		•				
Echinobeyrichia spinosa		•				
Abditoloculina triloculata		•				
Eoflaccivelum blussoni		•				
Alaskabolbina trinodosa		•				
Spinosteusloffina multispinosus		•				
Beecherella rhomboidalis		•				
Newsomites irregularis		•		•		•
"*Acanthoscapha*" *dorsiglobosa*		•				
?Palaeocopid indet. 3		•				
Palaeocopid indet. 1		•				
Signetopsis reticulata		•				
Delormobolbina binodosa		•				
Kiesowia? *decinodosa*		•				
Kolmodinia spinosa		•				
Eoacantonodella zaspelovae		•				
Beyrichia (Simplicibeyrichia) sp. 1		•				
Dolichoscapha sp. cf. *D. minuta*		•				
Dolichoscapha minuta		•				
Aechminaria equalis		•				
Pseudobeyrichia cristata		•				
Silenis proteus		•		•		
Undulirete mackenziensis		•		•		
Processobairdia delormensis			•			
Saccarchites? sp.				•		
Libumella sp. cf. *L. ambigua*				•	•	
Tubulibairdia sp.				•	•	
Dizygopleura? *borealis*				•	•	

Figure 8. *Occurrence of Silurian ostracodes, Avalanche Lake, Section 4 (AV4). T = talus.*

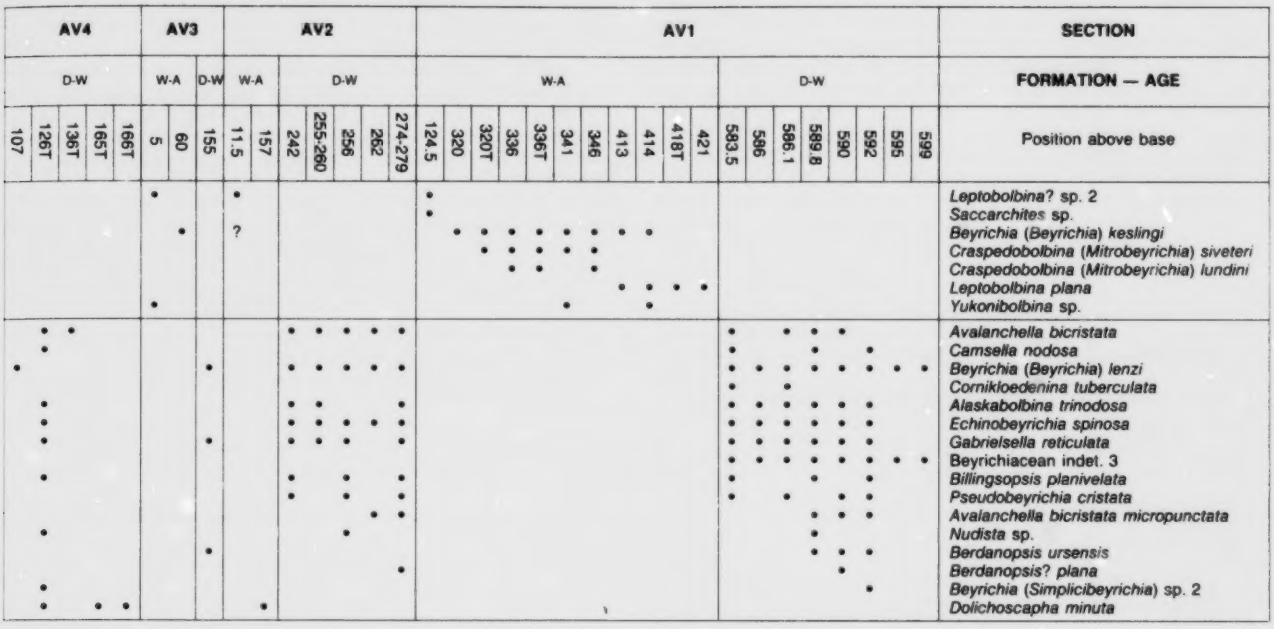


Figure 9. *Stratigraphic distribution of selected beyrichiacean species. W-A, Whittaker Formation – Anticosti Age; D-W Delorme Formation – Wenlock Age. T = talus.*

contains the beyrichiaceans *Alaskabolbina trinodosa* n. sp., *Avalanchella bicristata* n. gen., n. sp., *Echinobeyrichia spinosa* n. gen., n. sp., *Gabrielsella reticulata* n. gen., n. sp. and numerous other palaeocopid and podocopid genera. This is the same fauna recorded by Copeland (1978a) from Lenz's (1977) locality 2 at 300 to 330 ft. (91-101 m).

The youngest Delorme fauna contained in these collections is that from odontopleurid trilobite assemblage "k" of Section AV4. There, the ostracode fauna from localities AV4-165T m and AV4-166T m bears a distinctive dizygopleurid species. In appalachian North America, the dizygopleurid fauna starts within the *Drepanellina clarki* Zone, which is considered by Berry and Boucot (1970) to equate with the lower part of the Lockport Group (= late Wenlock). Species of *Dizygopleura*, however, occur well into the Devonian so the exact position of collections from localities AV4-165T m and AV4-166T m within the Silurian (late Wenlock, early Ludlow) is conjectural.

OSTRACODE BIOSTRATIGRAPHY

Figure 10 shows the writer's concept of a simplified Middle Ordovician to lower Middle Devonian ostracode biostratigraphic succession of that part of northern and northeastern Selwyn Basin discussed in this and several previous publications. Refinements of this schematic presentation will undoubtedly follow, especially with regard to the Upper Ordovician and lower Middle Devonian, because those faunas are at present relatively little known. Only data from beyrichiacean studies may permit a lineage to be postulated; no formal zonation is proposed because there are large stratigraphic gaps from which no silicified ostracode faunas have been recovered. Gabrielse et al. (1973, Table of Formations) estimated the maximum thickness of carbonate strata in this area as shown in Figure 10 herein (from the Sunblood Formation to the top of the Delorme), at approximately 3000 m. That portion of the shaly Road River Group on the same figure (correlative with the Whittaker and the Delorme formations) is probably 1000 m or more, which is about half of the assumed total thickness of that group in the Selwyn Basin.

A discussion of the North American affinities of the Middle Ordovician ostracodes from this area is contained in Copeland 1977 (p. 3) and need not be repeated. Only the uppermost Ordovician part of the Whittaker Formation has been reinvestigated herein from Sections AV1 and AV4B. The Ordovician ostracode occurrences are shown in Figures 2 and 3. In 1977 the occurrence of the European genus *Platybolbina* (*Reticulobolbina*) was reported from these strata. This genus is herein considered to mark the uppermost Ordovician in the Avalanche Lake area even though it ranges above the earliest occurrence of the conodont *Distomodus kentuckyensis*, a species considered as a conodont assemblage marker for the base of the Silurian (G.S. Nowlan, pers. comm., 1984). With *Platybolbina* are several ostracode genera that are not known to occur in the Silurian (see Appendices).

The earliest occurrence of a Silurian ostracode (locality AV1-124.5 m) is marked by the presence of poorly preserved beyrichiaceans of which *Leptobolbina*? sp. is a notable component. A species of this genus occurs in the subsurface rocks of Gotland, Sweden, a short distance above the Ordovician-Silurian contact. Whether a hiatus exists at the systemic boundary beneath Gotland is not known with certainty, so that the occurrence of *Leptobolbina* in the subsurface may only be considered as indicating a Llandovery age. As on Anticosti Island, Québec, the upper Anticosti strata of the Avalanche Lake area contain the first representative of the *Beyrichia* (*Beyrichia*) lineage that appears to dominate the rest of the Silurian and lower Devonian assemblages. *Beyrichia* (*B.*) *keslingi* of the upper

Whittaker Formation is succeeded by *Beyrichia (B.) lenzi* within the lower portion of the Delorme Formation. Section AV4, which contains the youngest strata of the Delorme Formation of this report, may range upward into the Ludlow, but there is no ostracode evidence to support such an age assignment.

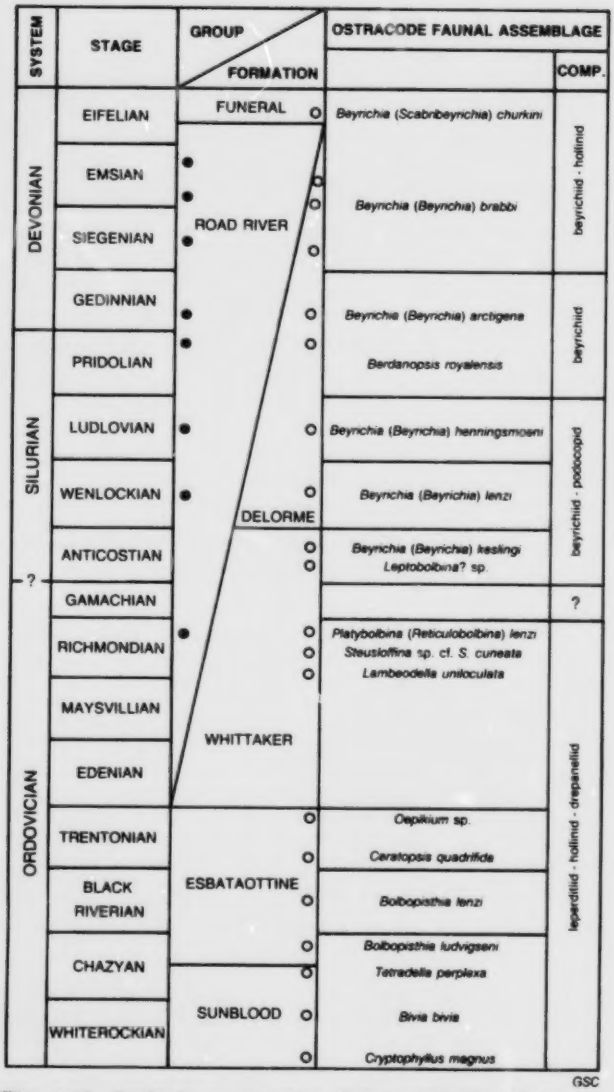


Figure 10. *Preliminary zonation of lower Middle Ordovician to lower Middle Devonian Ostracoda, Selwyn Basin and adjacent areas of southwestern District of Mackenzie, Yukon Territory and eastern Alaska, based on this and previous reports. Solid black dots indicate occurrence of zone fauna in basinal Road River facies rocks; open dots indicate occurrence of zone fauna in platformal rock sequences. COMP refers to the general generic composition of these faunas at higher taxonomic levels.*

SYSTEMATIC PALEONTOLOGY

The systematics will be discussed under two headings – Ordovician and Silurian. Ordovician faunas are illustrated mostly in Plates 1 to 3; Silurian faunas are shown generally in Plates 4 to 18. All specimens are deposited in the National Type Fossil Collection, Geological Survey of Canada, 601 Booth St., Ottawa, Ontario K1A 0E8.

Ordovician

Order PALAEOCOPIDA Henningsmoen, 1953

Suborder BEYRICHICOPINA Scott, 1961

Superfamily DREPANELLACEA Ulrich and Bassler, 1923

Family RICHINIDAE Scott, 1961

Genus *Parulrichia* Schmidt, 1941

Type species. ***Primitia diversa*** Jones and Holl, 1886.

***Parulrichia*? sp.**

Plate 3, figure 3

Description. Valves small, preplete, hingeline long, cardinal angles rounded. Surface smooth, with three nodes, anterior node relatively narrow, curved, convex anteriorly, posterior nodes larger, posterodorsal node hemispherical, posteroventral node ovate, more elevated than other nodes. S2 well defined. Length of figured specimen, GSC 72820, 0.3 mm, height 0.15 mm.

Type. Figured specimen, GSC 72820.

Remarks. This species differs from typical species of *Parulrichia* in having the posterior lobe divided into two distinct lobes. S2 is well developed, there are no marginal structures and the hingeline appears to be simple. It is possible that all of the specimens examined are steinkerns. The morphology of L2 and L3 of this taxon is characteristic of some species of *Quasibollia* Berdan, 1982, but the lack of ridgelike L1 and L4 makes an assignment to that genus difficult. Berdan (1982, p. H19) stated that quasibolliid species have "L1 and L4 merged with velar ridge". As parts of the velar structure, it is possible that L1 and L4 of quasibolliid species are solid structures that do not show internally and therefore are not present on steinkerns.

Family BOLLIIDAE Bouček

Genus *Bollia* Jones and Holl, 1886

Type species. ***Bollia uniflexa*** Jones and Holl, 1886, by subsequent designation.

***Bollia* sp.**

Plate 3, figure 16

Description. Valves subquadrate, dorsal and ventral margins subparallel, anterior and posterior margins evenly rounded. Marginal rim thread-like, approaching margin ventrally but well up on lateral domicilial surface anteriorly and

posteriorly, generally inconspicuous. Two dorsomedial lobes, joined ventrally, slightly below mid height of valve, anterior lobe club-shaped, diminishing in width ventrally to join ventral portion of the less inflated posterior lobe ventral of S2. Surface granular. Length of figured specimen, GSC 72833, 0.45 mm, height 0.25 mm.

Type. Figured specimen, GSC 72833.

Remarks. The small size, relatively poor preservation and somewhat indistinct ornamentation of this species preclude more specific identification.

Family AECHMINIDAE Bouček, 1936

Genus *Aechmina* Jones and Holl, 1869

Type species. Aechmina cuspidata Jones and Holl, 1869.

Aechmina wolfensis Copeland, 1977

Plate 1, figures 10, 11, 14, 15;
Plate 4, figure 31

Aechmina spp. Copeland in Ludvigsen, 1975, p. 691 (part).

Aechmina wolfensis Copeland, 1977, p. 27, Pl. V, figs. 1-3.

Types. Hypotypes, GSC 72773-72776.

Remarks. The specimens figured here show the dorsolateral extension of the spine but, because of preservation, lack the fine marginal spines of previously described specimens. The posterior dorsal projection shown in Plate 1, figure 15 may be extraneous silica adhering to the valve.

Aechmina overi n. sp.

Plate 2, figures 29, 30

Description. Valves slightly preplete, hingeline about 3/4 greatest length, cardinal angles rounded. Dorsal spine strong, slightly anterior of median area, directed posterodorsally. Marginal structure strong, extending along entire free margin, marked by numerous (up to 22?), evenly distributed, strong spines. Surface granular. Length of holotype, GSC 72817, 0.7 mm, height 0.4 mm.

Type. Holotype, GSC 72817.

Remarks. The strong spines on the marginal structure of this species distinguish it from other Upper Ordovician aechminid species previously reported from northwestern North America. *Aechmina bovina* Jones, 1887 from the Wenlock of Great Britain also displays marginal spines that are smaller, more numerous and not as evenly distributed as those of *A. overi* n. sp. and has a much more prominent, dorsally directed spine.

Aechmina spp.

Plate 1, figures 8, 9; Plate 2, figures 13, 27, 28;
Plate 3, figures 8, 9

Aechmina spp. Copeland in Ludvigsen, 1975, p. 691 (part).

Aechmina sp. Copeland, 1977, p. 27, Pl. V, figs. 6, 7.

Types. Figured specimens, GSC 72771, 72772, 72801-72803, 72825, 72826.

Remarks. Probably more than one species is represented here. The dorsal spine is distally relatively fragile, but the spine bases vary in size and position on the dorsolateral surface of the valve. Preservation of these specimens is generally coarse so that marginal structures are hidden or lacking.

Superfamily HOLLINACEA Swartz, 1936

Family EURYCHILINIDAE Ulrich and Bassler, 1923

Genus *Platybolbina* Henningsmoen, 1953

Subgenus *Platybolbina* (*Reticulobolbina*)
Schallreuter, 1969

Type species. Platybolbina (*Reticulobolbina*) *integra* Schallreuter, 1969.

Platybolbina (*Reticulobolbina*) *lenzi* Copeland, 1977

Plate 1, figures 1-3

Platybolbina (*Reticulobolbina*) sp. Copeland in Ludvigsen, 1975, p. 691.

Platybolbina (*Reticulobolbina*) *lenzi* Copeland, 1977, p. 29, Pl. V, figs. 12-20; Copeland, 1978, p. 97, Pl. 1, fig. 3.

Types. Hypotypes, GSC 72763-72765.

Remarks. Specimens of this species were originally recorded from Road River Group strata at Blackwolf Mountain some 20 km southwest of the Avalanche Lake sections discussed here. At Blackwolf Mountain this species occurs with conodonts that indicate Fauna 10? or younger (Tipnis et al., 1978). The younger age is assumed for the occurrence of this species at Avalanche Lake. Length of hypotype, GSC 72763, 1.4 mm, height 1.0 mm.

Genus *Eurychilina* Ulrich, 1889

Type species. Eurychilina reticulata Ulrich, 1889.

Eurychilina? sp. indet. 1

Plate 3, figures 4-6

Description. Valves elongate, hinge straight, about 9/10 greatest length, cardinal angles well defined. Preadductorial node small, about 1/4 valve height below hingeline, S2 small, pit-like, at posteroventral edge of L2. Valve anterior and posterior of L2-S2 low, relatively flat. Velum extending from anterior to posterior cardinal angles, a narrow ridge in some specimens, wide and flaring in others. Length of figured specimen, GSC 72821, 0.8 mm, height 0.425 mm.

Types. Figured specimens, GSC 72821-72823.

Remarks. No heteromorphs of this species have been found. Most specimens are relatively poorly preserved as the velar

portions and parts of the carapaces are broken and the valves are flattened. It would appear that the valve material of these specimens was very thin.

Family CHILOBOLBINIDAE Jaanusson, 1957

Genus *Cystomatochilina* Jaanusson, 1957

Type species. *Primitia (Ulrichia?) umbonata* Krause, 1892.

Cystomatochilina sp.

Plate 1, figure 16; Plate 2, figure 26

Description. Hingeline straight, about 3/4 greatest length of valve, hidden in lateral view beneath dorsal crests of anterior and posterior lobes. L1 low, with a dorsal crest, separated from preadductorial node by a weak depression, L2 prominent, hemispherical, in dorsal half of valve, S2 narrow, slit-like posterior of L2, deepest ventrally, posterior lobe broad, with a dorsal crest, joined to anterior lobe beneath S2. Velum complete, prominent, broadest anteroventrally. Surface pustulose. Length of figured specimen, GSC 72779, 1.2 mm, height 0.8 mm.

Types. Figured specimens, GSC 72779, 72816.

Remarks. This species is clearly dissimilar from *C. reticulotiara* Berdan, 1982 in that L2 is larger and consequently more elevated above the domicilium and the surface is pustulose rather than reticulate. *Cystomatochilina umbonata* (Krause), *C. tiara* (Henningsmoen) and *C. densistriata* (Henningsmoen) are pustulose species, but L2 of the first species is large and relatively low and L2 of each of the two latter species is smaller and the velum is pronouncedly striate.

Family HOLLINIDAE Swartz, 1936

Genus *Anticostiella* Copeland, 1973

Type species. *Anticostiella ellisensis* Copeland, 1973.

Anticostiella reticulata n. sp.

Plate 1, figure 13; Plate 2, figures 19-25

Description. Valves subelliptical in lateral view, dorsally truncated. Dorsum long, straight, slightly sunken between dorsal humps of L1 and L3. Venter broadly convex, running smoothly into anterior margin and slightly convergent posteriorly with dorsum. Cardinal angles obtuse, rounded.

Trilobate, L1 broad, separated from small, round L2 by an indistinct S1. L3 broad, occupying posterodorsal quarter of valve, separated from L2 by low, broad S2 and defined anteroventrally by the elevation of the broad ventral lobe. Ventral lobe passing indistinctly into basal part of L1, club-shaped, and elevated posteriorly, sometimes forming a posterior node. Surface reticulate.

Tecnomorphs with fine velar ridge and subvelar channel, heteromorphs with three large loculi ventrally and anteroventrally and anterior and posterior velar ridge. Locular area defined dorsally by a faint groove ventral of the velar lobe. Length of holotype, GSC 72814, 0.6 mm, height 0.4 mm.

Types. Holotype, GSC 72814, paratypes, GSC 72778, 72809-72813, 72815.

Remarks. Specimens of *A. reticulata* have broader lobation than *A. ellisensis* from the Ordovician Ellis Bay Formation and other *Anticostiella* species from Silurian strata of Anticosti Island, Québec. Consequently the lobes of *A. reticulata* are less well defined, the sulcation is less distinct and the loculi are nearly indistinguishable in lateral view. Also, S2 is poorly defined between L1 and the anterior margin of the ventral lobe.

Family PIRETELLIDAE Öpik, 1937

Genus *Bromidella* Harris, 1931

Type species. *Bromidella reticulata* Harris, 1931.

Bromidella obesa n. sp.

Plate 2, figures 6-8

Description. Valves somewhat preplete, anterior cardinal angle obtuse, posterior cardinal angle approximately 90°. Trilobate, L1 broad, connected with small L2; L3 broad, set off from L2 by well marked S2. Ventral lobe broad, connected anteriorly with L1, well marked off from L3, not extending to ventral margin of tecnomorphs, fused with velar dolon on heteromorphs. Internally, dolon well divided from ventral lobe by contact margin of valve. Heteromorphs with row of marginal denticles posterior of dolon. Surface granular. Length of holotype, GSC 72796, 0.8 mm, height 0.6 mm.

Types. Holotype, GSC 72796, paratypes, GSC 72794, 72795.

Remarks. The lobation of this species is less distinct than that of other species of the genus. The dolon is nearly indistinguishable from the broad ventral lobe in external view. The lobation of tecnomorphs may be confused with that of *Warthinia*, but species of that genus have a distinct velar rim around the free margin. Those species of *Eohollina*? sp. cf. *E.*? *irregularis* (Spivey) described by Copeland (1977, p. 27) as *Warthinia*? sp. cf. *W.*? *irregularis* (Spivey), from Blackwolf Mountain appear to have more distinct lobation than *B. obesa* n. sp. The distinction between heteromorphs of *Eohollina* and *Bromidella*, tecnomorphs of species of these genera, tecnomorphs of species of *Anticostiella* (the heteromorphs of which are loculate) and specimens of species of the, as presently understood non-dimorphic, genus *Warthinia* is a distinct problem.

Family TETRADELLIDAE Swartz, 1936

Genus *Lambeodella* n. gen.

Type species. *Lambeodella uniloculata* n. sp.

Description. Tetradellid ostracodes with weak L1, club-shaped L2, L3 and L4 joined ventrally at the histium, L3 extending above the hingeline as a prominent node, L4

prominent, node-like near mid height of valve, dorsally confluent with L3. Velum complete, tecnomorphs with prominent channel between histium and velum, channel less pronounced in heteromorphs. Antrum narrow in tecnomorphs, wide in heteromorphs. Heteromorphs with anterior loculus.

Discussion. Lobation of species of this genus is expressed by simple ridges superimposed on the domicilium, of the type present in some species of *Tetradella*. L4, however, may be interrupted near mid valve. Heteromorphs bear one loculus near the anterodorsal corner of the valve. The histial and velar structures are apparently in contact at the posterolateral corner of the somewhat squarish loculus with one or both structure(s) continuing anteriorly from near the mid anterior margin of the loculus to join the marginal structure at the anterodorsal corner of the valve.

Great variation in lobation exists within the Tetradellidae from the bilobate *Dilobella* to the quadrilobate *Tetradella*. The main feature common to all genera within the family is the presence of heteromorphic locular dimorphism. Even this feature varies widely from the four loculi of *Tetradella* Ulrich to the single loculus of *Pleurodella* Copeland and *Lambeodella* n. gen. It is possible that a division or subdivision of the family could prove to be of both taxonomic and stratigraphic significance.

Lambeodella uniloculata n. sp.

Plate 1, figures 12, 17-23, 25-28;
Plate 2, figures 1-5; Figure 11

Description. As for the genus.

Types. Holotype, GSC 72791, paratypes, 72777, 72780-72790, 72792, 72793.

Remarks. This species is remotely similar to *Pleurodella costata* Copeland, 1965, in that each bears an anterodorsal loculus. However, *P. costata*, also has the antrum divided mid ventrally by a vertical partition into two elongate "chambers". Whether these chambers serve as loculi in the true sense, or the partition is a strengthening feature, is unknown. Also, *P. costata* has broad lobes, each bearing a lobular ridge, whereas *L. uniloculata* n. sp. bears the lobular ridges directly on the domicilium. Length of holotype, GSC 72791, 1.6 mm, height 1.2 mm.

Family QUADRIJUGATORIDAE Kesling and Hussey, 1953

Genus *Homeokiesowia* Schallreuter, 1979

Type species. Kiesowia frigida Sarv, 1959.

Homeokiesowia sp.

Plate 2, figures 15-17

Description. Valves small, lobation entirely dissected but, with imagination, probably quadrilobate. L1 comprises 2-3? nodes, L2, L3 and L4 comprise 2 or 3 lobes, the most dorsal of each projecting above the hingeline. Velum narrow, extending from posterodorsal corner to above mid height of valve anteriorly. Well marked subvelar antrum. Only tecnomorphic specimens known. Length of figured specimen, GSC 72805, 0.45 mm, height 0.30 mm.

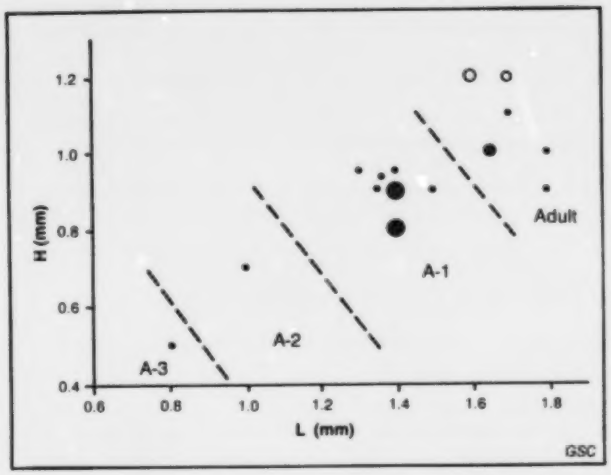


Figure 11. *Size-dispersion diagram for 23 specimens of* ***Lambeodella uniloculata*** *n. gen., n. sp. from the Whittaker Formation at locality AV1-53.5 m. Black dots (small to large) represent 1, 2 and 4 tecnomorphic specimens; open circles (small and large) represent 1 and 2 heteromorphic specimens.*

Types. Figured specimens, GSC 72805-72807.

Remarks. This species is most similar to *H. frigida* (Sarv) from C11B-D11B strata of Estonia and *H. margaritata* (Opik) from C2 - C3 strata of Estonia, but lacks the broader velum of the former species and the tuberculate velum of the latter. All three have very dissected lobation, but that of *Homeokiesowia* sp. described here lacks most, if not all, persistent lobal lineation resulting in questionable enumeration of nodes per lobe.

Superfamily OEPIKELLACEA Jaanusson, 1957

Family OEPIKELLIDAE Jaanusson, 1957

Genus *Oepikella* Thorslund, 1940

Type species. Oepikella tvaerensis Thorslund, 1940.

Oepikella sp.

Plate 2, figures 10-12

Types. Figured specimens, GSC 72798-72800.

Remarks. Poorly preserved specimens of a species of this Upper Ordovician genus were recovered at two localities in the Avalanche Lake sections. They greatly resemble species of the Middle to Upper Ordovician genus *Eoaquapulex* Levinson, 1968, but lack the height of *E. socialis* (Levinson), 1961, the type species. Both dimorphs are present, but the preservation is such that reliable comparison with described species is not possible. Length of figured specimen, GSC 72798, 2.3 mm, height 1.4 mm.

Suborder KLOEDENELLOCOPINA Scott, 1961

Superfamily LEPERDITELLACEA Ulrich and Bassler, 1906

Family LEPERDITELLIDAE Ulrich and Bassler, 1906

Genus *Leperditella* Ulrich, 1894

Type species. *Leperditella rex* Coryell and Schenck, 1941.

Leperditella sp. cf. *L. globosa* Sarv, 1959

Plate 1, figures 6, 7; Plate 3, figure 15

Leperditella globosa Sarv, 1959, p. 161, Pl. XXVIII, figs. 10-16.

Description. Leperditellid ostracodes with straight hingeline about 3/4 greatest length of valve, sometimes terminating in a short anterior projection. Free margins evenly rounded, preplete. Greatest width in median ventral area. Surface granular, possibly due to silicification. Length of hypotype, GSC 72770, 1.3 mm, height 1.0 mm.

Types. Hypotypes, GSC 72769, 72770, 72832.

Remarks. Most specimens are globose, as described by Sarv (1959) from Upper Ordovician (Fla, Flb) strata of Estonia, but some of those in the present study are considerably flattened without apparent breakage. The size of the present specimens are in the lowest range of those described by Sarv (1959, p. 161). He considered specimens in this size range as immature because they are less than half the size of his fully mature individuals. Whether the Avalanche Lake specimens are immature, dwarfed or possibly a smaller variation of an *L. globosa* type is unknown. The presence of a small anterodorsal projection on some of the present specimens may indicate their immaturity; this is a feature that may be lacking on more fully mature specimens.

Genus *Schmidtella* Ulrich, 1892

Type species. *Schmidtella crassimarginata* Ulrich, 1892.

Schmidtella? sp.

Plate 2, figure 9

Description. Valves nearly circular in lateral view, flat, unornamented, smooth; without marginal structures. Dorsal margin of valve slightly overhanging the hinge, which is relatively short. Length of figured specimen, GSC 72797, 0.7 mm, height approximately 0.7 mm.

Type. Figured specimen, GSC 72797.

Remarks. The circular outline of this species is distinctive. Reference of this species to *Schmidtella*? sp. is based on the lack of ornamentation and the hinge, which is slightly sunken beneath the dorsal margin of the valve.

Genus *Primitia* Jones and Holl, 1865

Type species. *Beyrichia mundula* Jones, 1865

Primitia? sp.

Plate 2, figure 14

Description. Subovate, hingeline straight, valve surface rising evenly from all margins to greatest width near mid valve. S2 straight, vertical, from dorsal margin to just above mid valve. Surface granular. Length of figured specimen, GSC 72804, 0.6 mm, height 0.3 mm.

Type. Figured specimen, GSC 72804.

Remarks. Specimens of this species are very fragile in the Avalanche Lake collections. Most are broken or disintegrate readily when touched. They are distinguished only by the presence of the sulcus and straight dorsal margin.

Order PODOCOPIDA Müller, 1884

Suborder METACOPIDA Sylvester-Bradley, 1961

Superfamily HEALDIACEA Harlton, 1933

Family BAIRDIOCYPRIDIDAE Shaver, 1961

Genus *Pheloparasclerites* n. gen.

Type species. *Pheloparasclerites berdanae* n. sp.

Included species. *Bairdiacypris incurvatus* Kraft, 1962.

Diagnosis. Ovoid bairdiocypridids with rounded cardinal areas, anterior more sloping than posterior. Left valve slightly overlapping right along free margin, right may overreach left dorsally. Lappet at mid ventral margin forming a slight concavity. Interior rib in position of adductorial sulcus, which is not (or only vaguely) expressed on the exterior of the valve.

Discussion. On external examination, species of this genus would be classified within the genus *Parasclerites* Swain, 1962 originally described from Chazy strata of the Lake Champlain area of New York. Internally, however, *Pheloparasclerites* species bear a marked vertical rib near or slightly anterior to mid length of the valve, extending from at or near the dorsal margin to mid height of the valve. Because this rib is not (or only vaguely) expressed on the exterior of the valve, differentiation between species of these two genera based on carapaces is difficult or impossible. The same difficulty is encountered in differentiating between species of the internally smooth *Phelobythocypris* Warshauer and Berdan, 1982 and internally biribbed *Cytherellina* Jones and Holl, 1869.

Pheloparasclerites berdanae n. sp.

Plate 3, figures 17-19

Description. Lateral outline elliptical, dorsal margin straight to slightly convex, subparallel to ventral margin, anterior and posterior margins curved, anterior margin sloping to greatest anteroventral length. Carapace about twice as long as high, left valve slightly overlapping right around the free margin, right valve may slightly overreach left valve dorsally. Slight ventral lappet on each valve at concavity of ventral margin.

Greatest height and width slightly posterior of mid length. Shell surface smooth, some specimens with a low vertical undulation slightly anterior of mid length. Interior of each valve with a well marked vertical rib extending from near the hinge to mid height of valve, possibly with an ovate area of muscle attachment on its anteroventral flank. Hingement simple. Length of holotype (a valve), GSC 72835, 1.95 mm, height 1.0 mm.

Types. Holotype, GSC 72835, paratypes, GSC 72834, 72836.

Remarks. *Pheloparasclerites berdanae* and *P. incurvatus* (Kraft) from the lower Middle Ordovician Lincolnshire and Edinburg formations of Virginia are very similar, but *P. berdanae* is less angular posteriorly and the internal vertical rib is less distinct than that of *P. incurvatus*.

Genus *Phelobythocypris* Warshauer and Berdan, 1982

Type species. *Leperditia* (*Isochilina*) *cylindrica* Hall, 1871.

Phelobythocypris cylindrica (Hall), 1871

Plate 2, figure 18

Type. Hypotype, GSC 72808.

Remarks. For a complete discussion and synonymy of this species refer to Warshauer and Berdan, 1982, p. H68, H69. The species is a consistent component of many North American Middle (Chazy?) to Upper (Richmond) Ordovician ostracode faunas. There is considerable size variation among the populations but the "bean" (usually concave ventrally) shape and greater posterior width (in dorsal or ventral view) are consistent factors in identification of the species. Length of hypotype, GSC 72808, 1.2 mm, width 0.5 mm.

Phelobythocypris sp.

Plate 3, figure 7

Type. Figured specimen, GSC 72824.

Remarks. Numerous specimens having elongate (L:H = approximately 3:1), ovate lateral outline are found in the present collections. These lack ornamentation but in general form may be assigned to *Phelobythocypris* sp. Length of figured specimen, GSC 72824, 1.1 mm, height 0.4 mm.

Family KRAUSELLIDAE Berdan, 1961

Genus *Krausella* Ulrich, 1894

Type species. *Krausella inaequalis* Ulrich, 1894.

Krausella spp.

Plate 1, figures 4, 5, 24; Plate 3, figures 1, 2

Description. Valves subovate, right valve drawn out into a blunt posteroventral spine. Greatest height and width at or posterior of mid length. Length of figured specimen, GSC 72767, 1.4 mm, height, 0.65 mm.

Types. GSC figured specimens 72766-72768, 72818, 72819.

Remarks. As with most krausellids it is extremely difficult to determine the generic affinity of disarticulated left valves. The collections contain numerous left valves attributed to *Krausella* spp. which, if right valves were unobtainable, could be assigned to the general term Bairdiocyprididae. Most of the present specimens are higher and wider posteriorly, the posterodorsal slope being somewhat abrupt and the anterodorsal slope gradually tapering to slightly below mid height of the valve.

Family unknown

Genus *Steusloffina* Teichert, 1937

Type species. *Steusloffina ulrichi* Teichert, 1937.

Steusloffina sp. cf. *S. cuneata* (Steusloff), 1895

Plate 3, figures 10-14

Primitia cuneata Steusloff, 1894, p. 782, Pl. 58, fig. 5a, b.

Steusloffina cuneata (Steusloff). Teichert, 1937, p. 120.

Steusloffina cuneata (Steusloff). Copeland, 1983, p. 202, fig. 23.2, 1-8.

Types. Hypotypes, GSC 72827-72831.

Remarks. All specimens recovered from the Avalanche Lake sections are much smaller and less well preserved than those reported by Copeland (1983) from Anticosti Island, Québec. Except for size, they agree in other respects with those specimens described by Hessland and Adamczak (1974) and other authors as occurring in uppermost Ordovician strata of the Baltic region. As with some of those specimens from Anticosti Island, the anterodorsal cardinal area of the Avalanche Lake specimens may be drawn out into a blunt (probably broken) spine (Pl. 3, figs. 10, 11) or rounded (Pl. 3, figs. 13, 14). All of the specimens figured here bear a broken single median lateral spine or the circular impression of the base of such a spine on the valve surface. Length of hypotype, GSC 72828, 1.2 mm, width 0.6 mm.

Silurian

Order PALAEOCOPIDA Henningsmoen, 1953

Superfamily BEYRICHIACEA Matthew, 1886

Subfamily CRASPEDOBOLBININAE Martinsson, 1962

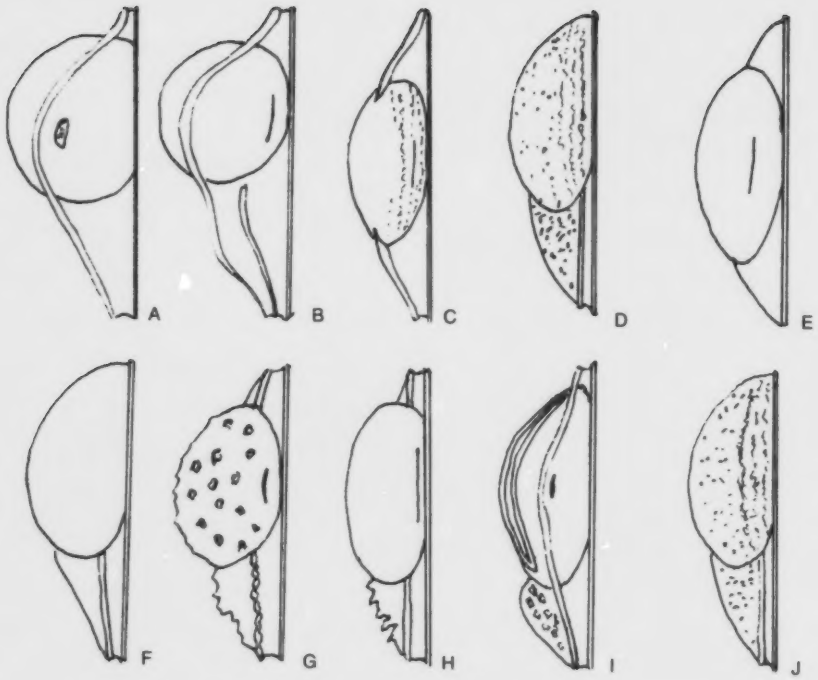
Genus *Leptobolbina* Martinsson, 1962

Type species. *Leptobolbina quadricuspidata* Martinsson, 1962.

Leptobolbina plana n. sp.

Plate 16, figures 14, 15, 18-20; Figure 12, A

Description. Elongate, preplete leptobolbinid species with abrupt cardinal angles; long, nearly straight dorsal margin may be slightly elevated above hinge. Without lobation



A. *Leptobolbina plana* n. sp.
B. *Leptobolbina*? sp. 1
C. *Apatobolbina elongidolonata* n. sp.
D. *Apatobolbina*? sp.
E. *Dolichoscapha minuta* n. sp.
F. *Craspedobolbina*? sp.
G. *Craspedobolbina (Mitrobeyrichia) siveteri* n. sp.
H. *Craspedobolbina (Mitrobeyrichia) lundini* n. sp.
I. *Avalanchella bicristata* n. gen., n. sp.
J. *Camsella nodosa* n. gen., n. sp.

Figure 12. *Diagrammatic representation of the ventral morphology of the crumina in 10 species of Beyrichiacea discussed herein.*

although there may be faint indication of adductorial muscle scar near mid valve. Velar ridge strong, tubulous, widest anteroventrally and abruptly narrowing posteriorly, narrow and slightly flexed dorsally where it crosses the crumina. Crumina hemispherical to slightly ovate, situated anteroventrally, with dolonoid scar, a small ovate notch slightly ventral of and removed from velar frill which completely crosses the crumina. Surface coarsely granular, ventral portion of crumina more finely granular.

Dimensions (mm).	Length	Height
Paratype, GSC 80873	1.20	0.8?
Holotype, GSC 80874	1.20	0.85
Paratype, GSC 80875	1.40	0.80
Paratype, GSC 80876	1.25	0.80
Paratype, GSC 80877	1.40	0.90

Types. Holotype, GSC 80874, paratypes, GSC 80873, 80875-80877.

Remarks. This species differs from *L. quadricuspidata*, the type species, in having the dolonoid scar ventral of and removed from the velum, and from *L. hypnodes* Martinsson, which has the velar ridge flexed ventrally to become incorporated with the dolonoid scar. The extension of the velum across the crumina is a leptobolbinid feature, whereas the position of the dolonoid scar on *L. plana* is an apatobolbinid feature. If either of these features have generic significance, *L. plana* may be a form intermediate between representatives of these two genera.

Leptobolbina? sp. 1

Plate 12, figure 7; Plate 16, figures 16, 17;
Figure 12, B

Description. Large, leptobolbinid-like species with long, straight dorsal margin, abrupt cardinal angles, and strong, thick, tubulous velum extending from anterior cardinal angles, widest anteroventrally, and narrowing on posterior margin to a mere ridge posterodorsally. Wide area between velum and marginal ridge with toric ridge extending to mid venter. Heteromorph with hemispherical, globular crumina, narrow, slit-like, near marginal dolonoid scar; velum crossing crumina uninterrupted. Surface granular.

Dimensions (mm).	Length	Height
Figured specimen, GSC 80878	1.40	1.00
Figured specimen, GSC 80879	2.20	1.45
Figured specimen, GSC 80880	1.90	1.30

Types. Figured specimens, GSC 80878-80880.

Remarks. The size differential between the dimorphs measured above is significant. Only one heteromorph, considered as probably conspecific with the tecnomorphic specimens, was available for study.

Leptobolbina? sp. 2

Plate 3, figures 25, 28;
Plate 4, figures 16, 17, 28, ?30;
Plate 16, figure 12

Description. Long, straight hingeline with 3 (4?) small, prominent dorsal spines extending above the hinge on well preserved specimens. Surface spinulose. Tubulous velum wide, extending from anterodorsal cardinal angle to posteroventral slope where it terminates as a spinose projection and diminishes abruptly in width to a velar ridge. Heteromorph unknown.

Dimensions (mm).	Length	Height
Figured specimen, GSC 72842	1.15	0.70
Figured specimen, GSC 72845	1.10	0.75
Figured specimen, GSC 80888	1.40	0.80

Types. Figured specimens, GSC 72842, 72845, 80888, 72676-72679.

Remarks. These specimens are somewhat similar to *L. tricuspidata* Martinsson or *L. quadricuspidata* Martinsson in having 3 (4?) processes extending dorsal of the hingeline. The abrupt posterior diminution of the velar structure and the abrupt, almost spinose cardinal angles are not typical of those species described from the Island of Gotland.

Genus *Apatobolbina* Ulrich and Bassler, 1923

Type species. Apatobolbina granifera Ulrich and Bassler, 1923.

Apatobolbina elongidolonata n. sp.

Plate 15, figure 10;
Plate 16, figures 21 - 23; Figure 12, C

Description. Elongate apatobolbinid species about twice as long as high. Faintly bilobate with almost indistinguishable muscle spot near mid valve. Dorsal margins of L1 and L3 overhang hinge slightly. Velar structure broad, tubulous, on tecnomorphs extending from obtuse anterior to posterior cardinal angles, slightly flexed dorsally near or just posterior of mid venter; on heteromorphs extending onto but not crossing the elongate, faintly striate crumina. Crumina with lunate dolonoid scar on ventral surface well removed from velar and marginal ridges. Surface of valves pustulose, almost forming reticulae, surface of crumina with pustules aligned, forming faint striae.

Dimensions (mm).	Length	Height
Paratype, GSC 80884	1.20	0.62
Holotype, GSC 80885	1.80	0.95
Paratype, GSC 80886	1.10	0.60

Types. Holotype, GSC 80885, paratypes, GSC 80884, 80886, 80904.

Remarks. Apatobolbina elongidolonata n. sp. is much more elongate than other species (i.e. *A. michiganensis* Martinsson from northern Michigan, *A. granifera* Ulrich and Bassler from Anticosti Island, Québec and *A. simplicidorsata* Martinsson from Gotland), which are all typically late Anticosti in age.

Apatobolbina sp.

Plate 4, figure 11

Type. Figured specimen, GSC 72684.

Remarks. This amplete species bears pronouncedly angular (approx. 90°) cardinal angles and has anterior and posterior dorsal elevations extending somewhat above the hingeline. The velum is complete, tubulous and thick and the domicilium is granular. There is no indication of lobation. No heteromorph referable to the tecnomorphic specimens has been observed. Length of figured specimen, GSC 72684, 1.8 mm, height 1.2 mm.

Apatobolbina? sp.

Plate 4, figure 8;
Plate 9, figure 30; Figure 12, D

Description. Non lobate; syllobium and ovate, anteroventral crumina finely reticulate. Velar flange thin, either not encroaching onto the crumina or becoming lost in faint striae on the ventral part of the crumina. Dolonoid scar not observed. Length of figured specimen, GSC 72486, 1.2 mm (now posteriorly broken), height 0.8 mm.

Types. Figured specimens, GSC 72486, 72697.

Genus *Dolichoscapha* Kesling and Ehlers, 1958

Type species. Dolichoscapha escharota Kesling and Ehlers, 1958.

Dolichoscapha minuta n. sp.

Plate 9, figure 31; Plate 10, figure 15;
Plate 11, figures 16, 18-20; Plate 12, figure 8;
Plate 14, figure 8; Figure 12, E

Description. Non lobate; syllobium and crumina finely reticulate. Crumina elongate, obscuring most of the venter, depressed dorsally at syllobium in position of muscle scar. Velar flange narrow, marginal, complete, dolonoid scar long, curving. Tecnomorph assumed to be specimen in Plate 11, figure 18, but the specimen is broken in the area of the muscle scar.

Dimensions (mm).	Length	Height
Holotype, GSC 72484	1.00	0.60
Paratype, GSC 72485	1.10	0.65

Types. Holotype, GSC 72484; paratypes, GSC 72485, 80844, 80845, 80894, 80898, 80935, 80940.

Remarks. The muscle scar in *D. escharota* is a central, smooth spot dorsal of the crumina, whereas that of the present species is at or slightly ventral of the dorsal edge of the crumina, causing a depression at the mid dorsal edge of the crumina. Whether the muscle spot is smooth or depressed is unknown.

Dolichoscapha sp. cf. *D. minuta* n. sp.

Plate 11, figures 28, 29

Type. Hypotype, GSC 80846.

Remarks. As *D. minuta* n. sp., but with a cruminal "strut" that is not present on heteromorphs of *D. minuta.* It is not known that the type or other species of *Dolichoscapha* possess this structure or that it is of specific or generic significance. However, the figured specimen is unique and removed from direct synonymy with *D. minuta* n. sp.

Kesling (1953) has demonstrated the presence of a similar "strut" for *Hibbardia lacrimosa* (Swartz and Oriel) and it is also known for *Treposella lyoni* (Ulrich), *Bolbiprimitia inaequalis* (Jones) (Martinsson, 1962) and *Treposella borealis* Berdan and Copeland. Whether this structure may have taxonomic significance, is a cruminal strengthening device, or is present on all heteromorphs of these species is unknown.

Genus *Craspedobolbina* Kummerow, 1924

Type species. Craspedobolbina dietrichi Kummerow, 1924, by monotypy.

Craspedobolbina? sp.

Plate 3, figures 29, 30;
Plate 4, figure 32; Figure 12, F

Description. Valves small, hinge straight, free margin evenly curved. L1 and L3 obsolete or represented only by low dorsal crests. L2 a low, round knob slightly anterior of mid valve. Crumina large, anteroventrally situated. Velar frill tubulous, complete, relatively broad and curved on tecnomorphs, apparently present only posterior of the crumina on the only heteromorphic valve observed.

Dimensions (mm).	Length	Height
Figured specimen, GSC 72846	1.10	0.85
Figured specimen, GSC 72847	1.10	0.70

Types. Figured specimens, GSC 72846, 72847, 72680.

Remarks. Preservation of the specimens precludes more exact taxonomic placement.

Subgenus *Mitrobeyrichia* Henningsmoen, 1954

Type species. Beyrichia jonesii Boll, 1856.

Craspedobolbina (Mitrobeyrichia) siveteri n. sp.

Plate 6, figures 10, 17, 22-27; Figure 12, G

Description. Amplete to preplete; hingeline long, straight, hidden by dorsal cusp of L1 and two dorsal cusps of L3. L1 low, separated from L2 by shallow S1. L2 ovate, unornamented, well below hingeline, joined to L3 by low zygal arch. L3 broad. Tecnomorphic velum complete, strong; that of heteromorphs strong posterior of crumina, weaker on anterior end. Crumina unornamented, rounded-ovate, occupying entire anteroventral portion of valve; with small admarginal dolonoid scar. L1 and contiguous L3 strongly pustulose with syllobial groove bounded ventrally by a row of stronger pustules.

Dimensions (mm).	Length	Height
Paratype, GSC 72710	1.95	1.40
Paratype, GSC 72711	2.00	1.30
Paratype, GSC 72712	2.00	1.50
Paratype, GSC 72713	1.80	1.30
Paratype, GSC 72714	1.90	1.35
Holotype, GSC 72715	2.20	1.60
Paratype, GSC 72716	2.00	1.30
Paratype, GSC 72717	2.10	1.60

Types. Holotype, GSC 72715, paratypes, GSC 72710-72714, 72716, 72717.

Remarks. This species is much more pustulose than most other species of the subgenus such as *C. (M.) variolata* Martinsson, and shows little development of the zygal arch. Also, unlike those species figured by Martinsson (1962), the syllobium bears two dorsal cusps that extend above the hingeline.

Craspedobolbina (Mitrobeyrichia) lundini n. sp.

Plate 6, figures 28-30; Figure 12, H

Description. Preplete, hinge long, hidden by dorsal cusp of L1 and double cusp of L3. L1 prominent, smooth; L2 ovate, smooth, joined to L3 by low zygal arch. L3 with 4 strong pustules aligned beneath syllobial groove and 3 or 4 less prominent pustules in dorsal half. Velar ridge strong posterior of smooth anteroventral crumina, less strong on anterior margin. Crumina with long, admarginal dolonoid scar. Tecnomorphic specimens not identified.

Dimensions (mm).	Length	Height
Paratype, GSC 72727	2.20	1.40 (broken)
Paratype, GSC 72728	1.80	1.30
Holotype, GSC 72729	1.90	1.30

Types. Holotype, GSC 72729, paratypes, GSC 72727, 72728.

Remarks. The pustulose nature of this species is somewhat similar to that of *C. (M.) siveteri* but the pustules (especially on the syllobium) are much larger, with 4 aligned ventral of the syllobial groove and 3 or 4 scattered in the dorsal half of L3. The dolonoid scar of *C. (M.) lundini* appears more admarginal and longer than that of *C. (M.) siveteri.*

Genus *Stroterobolbina* Siveter, 1980

Type species. Stroterobolbina floribunda Siveter, 1980.

Stroterobolbina? sp.

Plate 8, figure 4

Description. Valve preplete, hinge long, cardinal angles abrupt, about 100°. Trilobate, L1 low, broad, coalescing with anterior edge of L2; L2 hemispherical, low on valve, separated from wide L3 by shallow S2. L3 ornamented with scattered ridges. Crumina smooth, tear shaped, 2/3 anterior of S2. Velum extending from mid anterior and mid posterior margins onto crumina, apparently smooth. Dolonoid scar unknown. Length of figured specimen, GSC 72707, 1.9 mm, height 0.9 mm.

Type. Figured specimen, GSC 72707.

Remarks. No tecnomorphic specimens have been recognized. Siveter (1980, p. 36, 37) remarked on the strut-like spines incorporated within the velum of the type species. This cannot be detected on the present specimen possibly due to

the thickness of the velar structure. The tear-like shape of the crumina on the present specimen is most similar to those of species of *Hamulinavis* Martinsson, but the present specimen bears no posterior cruminal spine.

Unfortunately, the ventral portion of the crumina is broken in the dolonoid area. This precludes determination of the position and length of the dolonoid scar and also the extent to which the velum encroaches onto (or possibly across) the crumina.

Genus *Hyrsinobolbina* Martinsson, 1962

Type species. *Hyrsinobolbina hyrsinensis* Martinsson, 1962.

Hyrsinobolbina sp.

Plate 4, figure 2

Description. Preplete, hinge long, straight. Cardinal angles more than 90°. S1 obsolete, combined L1-L2 broad, L2 slightly more elevated than L1. S2 shallow, wider dorsally, extending to near mid valve. L3 broad, the most highly elevated lobe. Velum prominent, relatively straight, broad, tubulous, with a small spine-like projection at each cardinal angle. No heteromorphic specimens observed. Length of figured specimen, GSC 72694, 1.3 mm, height 0.9 mm.

Type. Figured specimen, GSC 72694.

Remarks. This specimen agrees in most respects with the type species but lacks the ornamental crest along the velar edge, and the tubules of the velum do not appear to have fine transverse wrinkles.

Subfamily TREPOSELLINAE Henningsmoen, 1954

Genus *Avalanchella* n. gen.

Type species. *Avalanchella bicristata* n. sp.

Included species. *Avalanchella bicristata* n. sp.; *Avalanchella bicristata micropunctata* n. subsp.

Diagnosis. Treposellinae with reticulate domicilium, smooth, cristate crumina without treposelline "bridges", and tubulous velar flange.

Description. Trilobate, lobes and sulci reticulate. Syllobium broad, elevated medially. L2 clearly distinguishable from L1. Crumina elevated from syllobium, smooth to finely granular, with cristal ridges. Complete, striate, tubulous velar flange. Dolonoid scar obsolete.

Discussion. Martinsson (1962, p. 199) presented the following diagnosis for the genus *Garniella*: "Treposellinae with reticulate lobes and cristae only on the crumina." *Avalanchella bicristata* n. sp. conforms to that broad diagnosis but differs from *Garniella lineolata* Martinsson, the type species of *Garniella*, which has a deep, clearly delimited S2 and the posterior part of the crumina fused with the syllobium. The domicilium of *A. bicristata* is completely reticulate, L2 and L1 are readily distinguishable, the velar flange is tubulous and passes across the crumina without treposelline "bridges".

Species of the genus *Treposella* may also be confused with *A. bicristata* in that they have reticulate domicilia and striate or cristate cruminae. *T. lyoni* (Ulrich), the type species of *Treposella*, has a striated crumina and *T. stellata* Kesling has a smooth crumina traversed by one strong crista. Kesling and Rogers (1957, p. 1005, 1006) and Kesling (1957, Pl. VI, fig. 6, Pl. VII, fig. 9) indicated that the velar structures of both those species encroach on (extend onto, but do not cross) the crumina. This has been confirmed by Kesling (pers. comm., 1982). Martinsson (1962, p. 211, fig. 97A), however, interpreted photographs of *T. lyoni* in Kesling and Rogers (1957, Pl. 127, figs. 1-3) as having "a small scar anteroventrally situated within the present velar flange" indicating, in his opinion, that *T. lyoni* has a "complete" velum.

From the foregoing it is apparent that *Treposella* (based on *T. lyoni*) and *Avalanchella* (based on *A. bicristata*) differ in velar morphology. The velum of *Treposella* encroaches onto the crumina without a dolonoid scar (*vide* R.V. Kesling) whereas the velum of *Avalanchella* is complete, but the dolonoid scar is likewise obsolete.

Avalanchella bicristata n. sp.

Plate 8, figures 25-31;
Plate 9, figures 2-8, 10; Plate 10, figures 23, 24;
Plate 12, figure 1; Figure 12, I

Description. Valves preplete, trilobate. L1 and syllobium elevated medially with low crest, united beneath L2 lobe and extending to or above the dorsal margin. L2 distinct, node like. Lobes and sulci coarsely reticulate. Velar flange complete, tubulous and striate, of near equal width throughout and flaring on tecnomorphs; of diminished width across the heteromorphic cruminа; without treposelline "bridges". Anteroventral crumina smooth to slightly granular, distinctly separated from the domicilium, with two cristae dividing the cruminа laterally into three nearly equal parts; cristae join posteriorly but do not reach the velar flange.

Dimensions (mm).	Length	Height
Holotype, GSC 72453	1.30	0.90
Paratype, GSC 72454	1.15	0.80
Paratype, GSC 72455	0.80	0.60
Paratype, GSC 72456	1.05	0.80
Paratype, GSC 72457	1.05	0.70
Paratype, GSC 72458	1.30	0.90
Paratype, GSC 72459	1.30	0.90
Paratype, GSC 72460	1.20	0.85
Paratype, GSC 72461	1.20	0.80
Paratype, GSC 72462	1.55	1.00
Paratype, GSC 72463	1.25	0.80
Paratype, GSC 72464	1.50	1.10
Paratype, GSC 72465	1.05	0.80
Paratype, GSC 72466	1.05	0.80
Paratype, GSC 72467	1.40	1.10
Paratype, GSC 72468	1.30	0.90
Paratype, GSC 72469	1.30	0.90

Types. Holotype, GSC 72453, paratypes, GSC 72454-72469, 72848.

Avalanchella bicristata micropunctata n. subsp.

Plate 8, figure 32; Plate 9, figure 1

Description. As for *A. bicristata* but of greater dimensions and with much finer domicilial and cruminal reticulation.

Dimensions (mm).	Length	Height
Holotype, GSC 72470	1.80	1.20
Paratype, GSC 72471	1.70	1.10

Types. Holotype, GSC 72470, paratype, GSC 72471.

Genus *Camsella* n. gen.

Type species. Camsella nodosa n. sp.

Diagnosis. Treposelline-like, with reticulate domicilium. Mid valve highly elevated. Crumina smooth to granular. Complete admarginal velar flange without treposelline "bridges", limited dorsally by long dolonoid scar along ventral edge of crumina.

Description. Non lobate or with slight dorsal depression above highly elevated, conical mid portion of domicilium. Crumina elevated posteriorly, but confluent with anterior domicilium, smooth to finely granular. Complete velar flange, nearly marginal and limited dorsally by long dolonoid scar on ventral part of crumina.

This genus may be intermediate between the Craspedobolbininae and Treposellinae. Apparent lack of lobation and the presence of a pronounced elevation slightly dorsal of mid valve precludes comparison with either the craspedobolbine *Clintiella* or treposelline *Bolbiprimitia.* Martinsson (1962, p. 190, 197) suggested that forms intermediate between the craspedobolbines and treposellines exist; they are, however, with the inclusion of *Camsella,* too diverse a group to be accommodated within a common taxonomic grouping.

Stone and Berdan (1984, p. 983) erected the genus *Paranoviportia* for reticulate, non-sulcate beyrichiaceans with an adductorial spot, non-striate crumina and an uninterrupted, narrow velum. That genus is very similar to *Camsella,* but the heteromorphic crumina of *Paranoviportia* is a poorly defined anteroventral swelling of the carapace, whereas that of *Camsella* is well defined and lacks reticulation.

Camsella nodosa n. sp.

Plate 9, figures 11, 12, 16, 18;
Plate 10, figures 27, 28, 32;
Plate 11, figures 24-26; Figure 12, J

Description. Valves preplete, non lobate or with low dorsal depression. Pronounced elevation slightly above mid height of valve. Domicilium coarsely reticulate. Velar flange complete, narrow. Crumina smooth or slightly granular, confluent with domicilium anteriorly and elevated posteriorly, with long ventral dolonoid scar limiting the dorsal margin of the velar flange.

Dimensions (mm).	Length	Height
Holotype, GSC 72472	1.30	0.80
Paratype, GSC 72473	1.30	0.75
Paratype, GSC 72474	1.05	0.60
Paratype, GSC 72475	0.90	0.50
Paratype, GSC 72476	1.20	0.70
Paratype, GSC 72477	1.25	0.65

Types. Holotype, GSC 72472, paratypes, GSC 72473-72477, 72675, 80841-80843.

Genus *Paranoviportia* Stone and Berdan, 1984

Type species. Paranoviportia reticulata Stone and Berdan, 1984.

Paranoviportia? sp.

Plate 15, figures 16, 17

Description. Hinge long, straight, hidden by dorsal elevation of lateral valve surface. Cardinal angles nearly 90°, anterior margin more narrowly rounded than posterior. Non-lobate, no evidence of S1 on the surface or interior of the valve. Complete, smooth velum; domicilium coarsely reticulate, rising evenly to mid point of valve. Heteromorph unknown.

Dimensions (mm).	Length	Height
Figured specimen, GSC 80853	0.80	0.50
Figured specimen, GSC 80854	0.85	0.50

Types. Figured specimens, GSC 80853, 80854.

Remarks. This species is questionably placed within *Paranoviportia* Stone and Berdan because of the lack of S1 and the evenly convex nature of the domicilium. The present species, however, has a much more pronounced velum, coarser reticulation and there is no evidence of a smooth adductorial spot. It differs from *Camsella nodosa* n. sp. in lacking the high, mid valve conical extension of the domicilium. As heteromorphs of *Paranoviportia*? sp. are unknown, the nature and ornamentation of the crumina are in question.

Genus *Gabrielsella* n. gen.

Type species. Gabrielsella reticulata n. sp.

Diagnosis. Treposellinae with reticulation over the entire carapace and crumina. Smooth, narrow velar flange. S1 obsolete. S2 thread-like, dorsal of well defined muscle spot. Crumina contiguous with domicilium.

Description. Bilobate, completely reticulate, except for median muscle spot and velum. L2 obsolete. S2 thread-like, inclined posteroventrally, ending dorsal of smooth muscle spot near mid valve. Crumina anteroventral, not set off from domicilium, sack-like. No dolonoid scar. Velar flange complete, narrow, reduced in width ventral of crumina.

This genus is similar in overall reticulation and cruminal and velar morphology to *Retisacculus* Martinsson, 1962 but has a narrow, unrestricted S2 and a smooth, central muscle spot on the domicilium. The crumina is not set off internally from the domicilium and forms a sack-like enlargement of the carapace wall.

Sethi (1979, p. 162) erected the genus *Jagatiella* for smooth to slightly punctate beyrichiids with faint S2, distinct muscle scar, crumina not set off from the domicilium and complete velar ridge. It was suggested (*ibid.*) that the zygobolbinid *Kiltsiella sarvi* Copeland from the Anticosti of Anticosti Island, Québec may belong to that genus. Sethi did not indicate that *Jagatiella* is a zygobolbinid but the heteromorphic specimen shown by him in Figure 51H would not appear to belong to the Zygobolbinae. *Jagatiella* therefore might appear to be somewhat similar to *Gabrielsella* in morphology but the inclined, thread-like sulcus and coarse domicilial reticulation of *Gabrielsella reticulata* n. sp. would justify the establishment of a new generic taxon.

Gabrielsella reticulata n. sp.

Plate 8, figures 21, 22;
Plate 9, figures 9, 13-15;
Plate 11, figure 17; Plate 12, figure 5;
Plate 14, figures 27, 28

Description. Valves amplete to slightly preplete, bilobate, lobes extending slightly above hingeline. L1 and L3 confluent ventrally beneath short, thread-like S2 and smooth, rounded muscle spot. Surface of valves and crumina reticulate. Crumina not set off from domicilium, a sack-like, ventral enlargement of the valve, nearly obscuring the velar flange along the ventral margin. Velar flange complete, narrow, diminishing in size beneath the crumina.

Dimensions (mm)	Length	Height
Holotype, GSC 72478	1.20	0.80
Paratype, GSC 72479	1.20	0.80
Paratype, GSC 72480	1.20	0.80
Paratype, GSC 72481	1.20	0.80
Paratype, GSC 72482	1.10	0.80
Paratype, GSC 72483	1.30	0.80

Types. Holotype, GSC 72478, paratypes, GSC 72479-72483, 80840, 80899, 80905-80942.

Subfamily AMPHITOXOTIDINAE Martinsson, 1962

Genus *Nudista* Siveter, 1980

Type species. Nudista cariticuspis Siveter, 1980.

Nudista sp.

Plate 8, figure 13; Plate 10, figure 22;
Plate 12, figure 6

Description. Trilobate amphitoxotidinae with broad syllobium, prominent L2 and low, almost indistinguishable L1. Lobes noncuspidate, only L3 extending slightly above the hingeline. Surface of heteromorphic valves smooth. Heteromorphic velum apparently nontubulous, extending from slightly anterior of prominent, ovate crumina, crossing crumina as a fine ridge curving toward the margin, slightly deflected back near mid length of the crumina and continuing posteriorly as a broader structure to near mid posterior margin. No torus observed. Subvelar area broad, posterior of crumina, very narrow anterior of crumina.

Dimensions (mm).	Length	Height
Figured specimen, GSC 72702	1.80	1.10
Figured specimen, GSC 72700	1.80	0.90
Figured specimen, GSC 80938	1.70	1.00

Types. Figured specimens, GSC 72700, 72702, 80938.

Remarks. No tecnomorphic specimens of this species have been recognized. Siveter (1980, p. 55) has shown that tecnomorphs of *N. cariticuspis* are somewhat reticulate, so it is entirely possible that tecnomorphic valves of the present species are not being recognized. However, no tecnomorphic specimens showing the relatively strong domicilial invagination and broad, tubulous post cruminal velum similar to that of *N. cariticuspis* have been observed. The present species differs from the type species in having a narrow velar ridge anterior of the crumina and in lacking a subvelar torus posterior of the crumina.

Genus *Cryptolopholobus* Martinsson, 1962

Type species. Cryptolopholobus semilaqueatus Martinsson, 1962.

Discussion. Martinsson (1962) erected two genera of somewhat similar morphology, *Lophoctenella* and *Cryptolopholobus*, to accommodate Amphitoxotidinae with a strongly reduced L1, cristal loops on certain of the lobes, and a denticulate velar crest, especially on tecnomorphic specimens. Differentiation between these genera may depend on whether the tecnomorphic L1 joins L2 and L3, that of *Lophoctenella* being isolated, whereas that of *Cryptolopholobus* is contiguous with the more posterior lobation ventral of the preadductorial lobe.

Cryptolopholobus sp.

Plate 13, figure 29

Description. Only the tecnomorphic valve is known. Preplete, anterior margin more narrowly curved than the posterior margin. Hingeline straight, long, hidden in lateral view by dorsal crests of L1 and L3. Trilobate, L1 a curved ridge joining the node-like L2 near mid valve. L3 a long, anteriorly vertical lobe with a pronounced cristal loop on its dorsal two-thirds, joining L1 - L2 by a deeply curved lobal ridge. The posterior portion of the cristal loop is reduced to a curved row of denticles on the posterior surface of the domicilium. L1 and S2 prominent. Lobation set off from velum by a deep, smooth channel. Velar ridge complete, prominent, with a denticulate velar crest. Deep subvelar channel; marginal ridge spinose. Length of figured specimen, GSC 80928, 1.0 mm, height, 0.7 mm.

Type. Figured specimen, GSC 80928.

Remarks. This species differs from the genotype, *C. semilaqueatus*, by having a cristal loop only on L3, L1 and L3 extending above the hingeline, L2 situated lower on the valve and the spinose marginal ridge. As no heteromorphic specimens have been identified it is desirable to leave the species in open nomenclature.

Subfamily ZYGOBOLBINAE Ulrich and Bassler, 1923

Genus *Perrybolbina* n. gen.

Type species. Perrybolbina bicuspidata n. sp.

Diagnosis. Zygobolbinae with external lobation consisting only of the dorsal cusps of L1 and L3; some indication of L2 and S2 interiorly. Heteromorphs with long, ventral crumina and narrow anterior and posterior velar ridge; tecnomorphs with wider, complete velum. Dolonoid scar breaking through the margin.

Remarks. Only the type species is known; it apparently represents a stage intermediate in morphology between the non-sulcate *Noviportia* Martinsson, 1962 from the Llandovery of Gotland and Anticosti of Anticosti Island with its high dorsal plica, and *Kiltsiella* Sarv, 1968 from similarly aged strata in Estonia and Anticosti Island, which typically bears a narrow, vertical S2 and dorsal plica on L1 and L3. Those genera, with *Perrybolbina* n. gen., represent a group of zygobolbinids entirely distinct from the typical, lobate Appalachian group represented by *Zygobolba* Ulrich and Bassler, 1923.

Perrybolbina bicuspidata n. sp.

Plate 14, figures 9-19; Plate 15, figures 11, 12

Description. As for the genus. Surface granular. Length of holotype, GSC 80803, 1.2 mm, height 0.9 mm.

Types. Holotype, GSC 80803, paratypes, GSC 80802, 80804-80813.

Remarks. Two specimens (Pl. 14, figs. 15, 19) show aberrant velar structures, that of the first with the velum being directed laterally and terminating abruptly near the mid point of the venter and that of the second being abruptly flexed near mid venter but continuing posteriorly. These two specimens are either adult or A-1 and show somewhat similar development to that of the cruminal metamorphosis demonstrated by Martinsson (1962, figures 28C and 34B).

Subfamily BEYRICHIINAE Matthew, 1886

Genus *Beyrichia* M'Coy, 1846

Type species. Beyrichia Klodeni M'Coy, 1846.

Subgenus *Beyrichia* (*Beyrichia*) M'Coy, 1846

Type species. Beyrichia Klodeni M'Coy, 1846.

Beyrichia (*Beyrichia*) *keslingi* n. sp.

Plate 6, figures 12-16, 18-21;
Plate 12, figures 12, 15

Description. Beyrichiine with uninterrupted, wide connection between L1 and L3. Hingeline long, straight, hidden by double dorsal cusps of L1 and L3. L2 prominent, low on valve, connected to L3 by low zygal arch. Heteromorph with prominent, ovate crumina occupying entire anteroventral margin of valve, erasing all but dorsal cusps of L1. S2 prominent, joining S1 dorsal of L2. Surface tuberculate except for sulci and area in position of syllobial groove. Velar ridge prominent and tuberculate in tecnomorphs, a row of spinose tubercles in heteromorphs that is discontinuous beneath completely tuberculate crumina. Immature specimens (A-2) may bear what appears to be an anterior acroidal spine and a spinose tubercle in the position of a calcarine spine; these are lacking on more mature specimens.

Dimensions (mm).	Length	Height
Paratype, GSC 72718	1.80	1.30
Paratype, GSC 72719	1.70	1.10
Paratype, GSC 72720	1.80	1.25
Paratype, GSC 72721	1.10	0.70
Holotype, GSC 72722	1.90	1.30
Paratype, GSC 72723	1.90	1.30
Paratype, GSC 72724	1.90	1.30
Paratype, GSC 72725	2.00	1.30
Paratype, GSC 72726	1.80	1.30

Types. Holotype, GSC 72722, paratypes, GSC 72718-72721, 72723-72726, 80865, 80868.

Remarks. This species differs from most other species of the subgenus in having L1 bicuspate and in lacking a ventral striate field on the crumina. The area on which the syllobial groove and callus occurs on most other species is marked only by a lack of tuberculation rather than a linear depression.

Beyrichia (*Beyrichia*) *lenzi* Copeland, 1978

Plate 7, figure 15; Plate 10, figures 1-14

Beyrichia (*Beyrichia*) sp. 1 Copeland, 1977, p. 20, Pl. 1, figs. 5, 6.

Beyrichia (*Beyrichia*) *lenzi* Copeland, 1978, p. 66, Pl. 11.1, figs. 14-23.

Types. Hypotypes, GSC 72660-72673, 72745.

Remarks. Specimens of what are considered to be the last 5 instars of this species have been recognized in the present collections; these are shown in Plate 10.

Dimensions (mm).	Length	Height
Adult sp.		
Hypotype, GSC 72660	2.10	1.60
Hypotype, GSC 72664	2.60	1.60
Hypotype, GSC 72665	2.20	1.60
Hypotype, GSC 72666	2.40	1.50
Hypotype, GSC 72672	2.40	1.50
Hypotype, GSC 72745	2.60	1.60
Adult-1		
Hypotype, GSC 72661	1.90	1.40
Hypotype, GSC 72663	1.90	1.40
Hypotype, GSC 72667	1.90	1.30
Hypotype, GSC 72670	2.00	1.30
Adult-2		
Hypotype, GSC 72671	1.70	1.10
Adult-3		
Hypotype, GSC 72662	1.30	0.90
Hypotype, GSC 72668	1.50	0.90
Hypotype, GSC 72673	1.40	0.90
Adult-4		
Hypotype, GSC 72669	1.20	0.70

In all instars the ornamentation is more concentrated in the ventral half of the valves, but it appears that the younger the instar, the more spinose the ornamentation. On some adult-4 and adult-3 specimens a slightly more pronounced spine may be developed in the calcarine position, but this is not present on more mature specimens. In no instar examined does there appear to be evidence that L1 or L3 are what may be termed cuspidate. Also, the crumina or velar margins of both dimorphs are pustulose.

Beyrichia (*Simplicibeyrichia*) Martinsson, 1962

Type species. Beyrichia (*Simplicibeyrichia*) *globifera* Martinsson, 1962.

Beyrichia (*Simplicibeyrichia*) sp. 1

Plate 11, figure 15

Description. Valve somewhat preplete. Hinge long, straight, cardinal angles abrupt, somewhat obtuse, both with an acroidal spine. Trilobate, L1 represented only by a pointed dorsal cusp extending above the hingeline, L2 broad, elevated, closely appressed to L1. L3 broad, joined ventrally

to L1 - L2. L3 with a prominent, long calcarine spine ventral and slightly posterior of S2 and prominent, pointed dorsal cusp extending above the hingeline. S1 indistinct, present along the anterodorsal margin of L2, interrupted dorsally by a small spinule. S2 relatively deep, extending to mid valve, slightly anterodorsal of calcarine spine. Velum a low row of tubercles parallel to and close to the marginal ridge. Domicilial surface randomly tuberculate. Heteromorph unknown. Length of figured specimen, 1.6 mm, height 1.05 mm.

Type. Figured specimen, GSC 80863.

Remarks. Martinsson erected this genus to include beyrichiaceans with limited ornamentation except for dorsal cusps and with or without a calcarine spine. The cardinal angles on the Gotland species he described are abrupt and pointed but do not have acroidal spines as in the present species. This latter feature may be the result of variation in type of preservation between the Gotland material and that of the Avalanche Lake specimens. Dimorphs of the type taxon, *B. (S.) globifera*, as illustrated by Martinsson, may not represent the same species as there is relatively little resemblance between the two. The present species differs from those species illustrated by Martinsson in having much more prominent dorsal cusps and a longer calcarine spine. In these respects it somewhat resembles species of *Calcaribeyrichia* Martinsson, 1962 but does not have the lobal differentiation present on species of that genus.

Beyrichia (Simplicibeyrichia) sp. 2

Plate 12, figure 11

Description. Hinge straight, long; cardinal angles obtuse, valve preplete. All lobation low, S1 almost obsolete, L1 and L3 joined broadly beneath indistinct S2. Surface granular with randomly distributed pustules. Calcarine spine prominent, long, posteroventral of S2. Velar structure a complete row of spinules close to and parallel with marginal ridge. Heteromorph unknown. Length of figured specimen, 1.0 mm, height 0.6 mm.

Type. Figured specimen, GSC 80864.

Remarks. Certain of the species of *B. (Simplicibeyrichia)* erected by Martinsson (1962) lack dorsal cusps on L1 and L3 as does the present species. All, however, possess a calcarine spine and most have pustules scattered randomly across the domicilium. The lobation of the present species is less distinct than that of the described species from Gotland and there is no indication of a syllobial groove.

Genus *Echinobeyrichia* n. gen.

Type species. Echinobeyrichia spinosa n. sp.

Diagnosis. Beyrichiinae wth uninterrupted, wide connection between L1 and L3 without dissection of L3 and L1 into lobular areas, no lobal cusps, but with development of conspicuous calcarine, uncular, acroidal and intervening spines forming a supravelar row of spines. Crumina situated anteriorly, not plicate; velar structure a row of smaller spines complete beneath crumina. Surface, including crumina, spinose.

Discussion. Lack of lobular dissection is typical of species of *Beyrichia (Beyrichia)* but the presence of acroidal, uncular and calcarine spines incorporated in a supravelar row of spines is similar to that of some species of *Beyrichia (Scabribeyrichia)*. There is no syllobial groove or callus on *E. spinosa* but the narrow area dorsal of the supravelar row of spines is usually unornamented. The presence of four or more prominent dorsal spines between the acroidal processes is somewhat unique; these occur randomly along the dorsal margin and do not appear to have a morphological relationship to the dorsal cusps present on many other beyrichiines.

Martinsson (1962, p. 304, Figures 11A-B) described a taxon *Beyrichia (incerti subgeneris) erinacea* from the Slite Beds (Wenlock) of Gotland that may bear some relationship to *E. spinosa* n. sp. The Gotland species is known only from heteromorphic specimens that Martinsson tried unsuccessfully to relate to *Beyrichia* (aff. *Scabribeyrichia*) sp. Both of those species bear tuberculation near the hingeline above S2 in the position of one or two of the curved dorsal spines of *E. spinosa*, and on *B. erinacea* the "crumina has a markedly anterior position" (Martinsson, 1962, p. 304) similar to that of *E. spinosa*. However, this appears to be the only similarity between those Gotland species and *E. spinosa*.

Echinobeyrichia spinosa n. sp.

Plate 7, figures 1-14, 16-32;
Plate 12, figures 13, 14, 16

Description. Valves preplete to amplete; hinge long, straight; cardinal angles about 90°. Trilobate, L1 low, indistinct, L2 globular, L3 broad, joined to L1 beneath L2. S1 indistinguishable, S2 posterior of L2, curved, about half valve height. Cardinal angles with pronounced acroidal spines, anterior acroidal spine nearly vertical, posterior acroidal spine extending posterodorsally at about 135° to the hingeline. Dorsal margin with up to 6 prominent backwardly curving spines. Free margin with a complete series of smaller velar spines. Supravelar row of up to 9 large spines extending to each cardinal angle almost parallel to the free margin beneath L2 and incorporating acroidal, calcarine and uncular processes. Surfaces of lobes and crumina with coarse tubercles and spines.

Crumina ovate to hemispherical, situated anteriorly, extending up to two-thirds the greatest height of the valve. Spines on crumina tending to have some linearity parallel with the anteroventral valve margin on some specimens.

Dimensions (mm).	Length	Height
Paratype, GSC 72731	1.20	0.70
Paratype, GSC 72732	1.30	0.70
Paratype, GSC 72733	1.50	0.80
Paratype, GSC 72734	1.60	0.90
Paratype, GSC 72735	1.30	0.70
Paratype, GSC 72736	1.05	0.60
Paratype, GSC 72737	1.40	0.80
Paratype, GSC 72738	1.30	0.80
Paratype, GSC 72739	1.30	0.80
Paratype, GSC 72740	1.50	0.85
Paratype, GSC 72741	1.40	0.80
Paratype, GSC 72742	1.30	0.75
Paratype, GSC 72743	1.50	0.95
Paratype, GSC 72744	1.50	0.95
Paratype, GSC 72746	1.55	0.95
Paratype, GSC 72747	1.50	0.90
Paratype, GSC 72748	1.55	0.90
Holotype, GSC 72749	1.50	0.90
Paratype, GSC 72750	1.60	1.00

Dimensions (mm).	Length	Height
Paratype, GSC 72751	1.40	0.90
Paratype, GSC 72752	1.20	0.60
Paratype, GSC 72753	1.00	0.60
Paratype, GSC 72754	1.15	0.60
Paratype, GSC 72755	1.15	0.70
Paratype, GSC 72756	1.20	0.70
Paratype, GSC 72757	1.20	0.70
Paratype, GSC 72758	1.30	0.75
Paratype, GSC 72759	1.30	0.80
Paratype, GSC 72760	1.15	0.85
Paratype, GSC 72761	1.30	0.70
Paratype, GSC 72762	1.30	0.75
Paratype, GSC 80866	1.20	0.70
Paratype, GSC 80867	1.30	0.80
Paratype, GSC 80869	1.30	0.70

Types. Holotype, GSC 72749, paratypes, GSC 72731-72744, 72746-72748, 72750-72762, 80866, 80867, 80869.

Genus *Berdanopsis* Copeland, 1977

Type species. Berdanopsis royalensis Copeland, 1977.

Berdanopsis? *planus* n. sp.

Plate 13, figures 24-26

Description. Valve amplete, trilobate, with L1 and L3 extending above the long, straight hingeline. Cardinal angles abrupt, about 100°. L1 curved posteriorly with sharp dorsal crest extending ventral of large, hemispherical L2 and joining with sharp dorsal crest of near vertical L3. A less distinct posterior crest arising from near the base of L3 and extending upward to near the hinge. S2 deeper than S1, both sulci tending to join ventral of L2. Valve channelled between lobate portion and complete velar flange. Subvelar area channelled to marginal ridge. Surface of entire valve seemingly smooth to faintly reticulate. Heteromorphs unknown.

Dimensions (mm).	Length	Height
Paratype, GSC 80930	1.25	0.80
Holotype, GSC 80931	1.25	0.85

Types. Holotype, GSC 80931, paratype, GSC 80930.

Remarks. Berdanopsis? *planus* differs from *B. royalensis* and *B. ursensis* in having broader lobation and lobal crests that are less elevated above the domicilium. The valve surface is seemingly smooth rather than granulo-reticulate as are some specimens of the latter species.

Berdanopsis ursensis Copeland, 1977

Plate 13, figure 23

Berdanopsis ursensis Copeland, 1977, p. 22, Pl. X, figs. 19, 20, 22-25; Pl. XV, figs. 3, 14; Copeland, 1978, Pl. 11.1, fig. 8; Stone and Berdan, 1984, p. 990.

Type. Hypotype, GSC 80929.

Remarks. This species appears to be of relatively limited distribution in the Avalanche Lake sections. Few specimens were obtained. Length of figured specimen, GSC 80929, 0.8 mm, height 0.6 mm.

Berdanopsis sp. cf. *Berdanopsis ursensis* Copeland, 1977

Plate 16, figures 24-26

Dimensions (mm).	Length	Height
Hypotype, GSC 80881	1.20	-
Hypotype, GSC 80882	1.00	0.70
Hypotype, GSC 80883	-	0.90

Types. Hypotypes, GSC 80881-80883.

Remarks. The most complete specimen is an immature tecnomorph (A-1?) that displays the characteristics of the type specimens from elsewhere in the Delorme Formation. Of two of the imperfect heteromorphic specimens, one (GSC 80881) bears more numerous cristae crossing the crumina and the other (GSC 80883) bears the dorsal crista and remnants of a more ventral crista on the crumina. Possibly the latter specimen is abraded.

Berdanopsis royalensis Copeland, 1977

Plate 12, figure 18

Berdanopsis royalensis Copeland, 1977, p. 22, Pl. X, figs. 18, 21; Pl. XV, figs. 2, 10-13; Pl. XVI, figs. 5-10; Copeland, 1978, Pl. II, fig. 14; Stone and Berdan, 1984, p. 990.

Type. Hypotype, GSC 80944.

Genus *Comikloedenina* Abushik, 1971

Type species. Comikloedenia althi Krandijevsky, 1963.

Comikloedenina? *tuberculata* n. sp.

Plate 8, figures 5, 6; Plate 13, figures 18-22

Description. Valves amplete to preplete; dorsal margin long, straight; cardinal angles abrupt, each more than 90°, posterior cardinal angle may bear an acroidal spine. Trilobate, L1 low, separated from L2 by an indistinct S1; L2 low, broad, joined ventrally to domicilial surface, separated from low, broad L3 by shallow S2. L3 with an anteroventral spine slightly posterior of ventral part of S2. Anteroventral margin of tecnomorphic valves with up to 4 anteriorly directed spines. Crumina of heteromorphs an anteroventral swelling of the domicilium obliterating L1 and closely joined to L2. Velum a near marginal bend from which the tecnomorphic spines arise.

Dimensions (mm).	Length	Height
Holotype, GSC 80847	1.50	0.95
Paratype, GSC 80848	1.10	0.70
Paratype, GSC 80849	1.00	0.70
Paratype, GSC 80850	1.20	0.75
Paratype, GSC 80851	1.15	0.80
Paratype, GSC 72525	1.20	0.70
Paratype, GSC 72526	1.35	0.85

Types. Holotype, GSC 80847, paratypes, GSC 80848-80851, 72525, 72526.

Remarks. This species appears to differ from all other species of the genus in possessing anteroventral velar spines

and a posterodorsal acroidal spine on the tecnomorphs. Also, the heteromorphic crumina is not as distinctly set off from the domicilium as in those species described by Abushik (1971), L2 is not cristate and is situated rather low on the valve. *Cornikloedenina lorangerae* Copeland, 1977 bears more prominent lobation, the crumina is more distinctly set off from the domicilial surface and there is no indication of anteroventral velar spines. That species is known only from steinkerns, but the lack of any vestige of a velar structure precludes the placement of *C. tuberculata* within *C. lorangerae*.

Genus *Pseudobeyrichia* Swartz and Whitmore, 1956

Type species. Pseudobeyrichia peromata Swartz and Whitmore, 1956.

Pseudobeyrichia cristata n. sp.

Plate 8, figures 9-12

Description. Outline semicircular, hinge straight; slightly preplete, cardinal angles more than 90°. Trilobate, L1 and L3 ridge-like, joined ventral of L2, extending above hinge; L2 low, broad, situated slightly anterior of mid valve in dorsal half of valve. S1 deep, concave posteriorly, ending ventral of L2. A low ridge posterior of carinate ridge joining L1 and L3, rising from near base of L3, curving parallel with L3 and extending to near dorsal margin. Velar flange broad, extending from anterior to posterior cardinal angles.

Heteromorph with large crumina occupying centroventral third of carapace, obscuring all but the most dorsal part of L1. Ridge between L1 and L3 continues much diminished in width across the crumina. Velar flange comprises two narrow ridges that cross the ventral part of the crumina, single broader flange posterior of crumina.

Subvelar field of both dimorphs broad. Surface finely granular.

Dimensions (mm).	Length	Height
Holotype, GSC 72626	1.30	0.80
Paratype, GSC 72624	1.15	0.80

Types. Holotype, GSC 72626, paratypes, 72624, 72625, 72627.

Remarks. This species is most similar to *Pseudobeyrichia ventrilirata* Hoskins from the Bloomsburg Formation (Ludlow) of Pennsylvania. *Pseudobeyrichia ventrilirata*, however, bears two carinae near mid valve joining L1 and L3, the tecnomorphs apparently have a subvelar torus(?). As with *P. cristata*, the velar ridge of *P. ventrilirata* appears to split into two subcruminal ridges on heteromorphs.

Genus *Welleriella* Abushik, 1971

Type species. Welleriella prostrata Abushik, 1971.

Welleriella? sp.

Plate 11, figure 27

Description. Postplete, hinge straight, about 3/5 greatest length. Anterior margin more broadly curved than posterior margin. Ventral margin parallel with hingeline. No exterior lobation, interiorly L2 is visible as a shallow depression anterior of mid valve but not reaching dorsum. Muscle area visible exteriorly, smooth, apparently tear shaped. Crumina sausage shaped, long, extending most of the length of the ventral part of the valve, only set off from the rest of the domicilium as a low swelling. No velar structure; surface granular. Length of figured specimen, GSC 80939, 1.65 mm, height, 1.0 mm.

Type. Figured specimen, GSC 80939.

Remarks. This species bears no evidence of external ornamentation, except for the teardrop shaped muscle field that depresses the mid dorsal part of the cruminal bulge. There is no velar structure, only a faint marginal ridge. In specimens of *W. prostrata* Abushik the lobal ornamentation may or may not be observed but heteromorphic specimens bear the crumina in an anteroventral position.

Genus *Welleriopsis* Swartz and Whitmore, 1956

Type species. Welleriopsis diplocystulis Swartz and Whitmore, 1956.

Welleriopsis? sp.

Plate 10, figure 17

Description. Preplete, hinge long, straight, cardinal angles abrupt, about 90°. Valve margin smoothly curved. L1 indistinct, joined to ovate L2, which does not meet the dorsal margin. S2 relatively deep, extending to mid valve. L3 broad, low. Left valve overlapping right along mid anterior to mid posterior margin. Low velar structure along mid venter of left valve. Surface granular. Length of figured specimen, 1.35 mm, height 1.0 mm.

Type. Figured specimen, GSC 72703.

Remarks. The ventral margin of the right valve of the figured specimen is missing, giving the specimen a gaping appearance. However, the contact margin of the left valve is visible as well as the low, mid ventral velar structure on the left valve. Whether a similar structure may have been present on the right valve is unknown.

Distinction between *Welleria* and *Welleriopsis* is difficult. However, it appears that S1 is not well developed on *Welleriopsis* species and is present on *Welleriopsis*? sp. only as the juncture of the low L1 platform and the more elevated ovate S2. This is also true of *W. jerseyensis* (Weller), which, however, bears a more marked marginal ridge.

Genus *Bingeria* Martinsson, 1962

Type species. Bingeria zygophora Martinsson, 1962.

Bingeria? sp.

Plate 4, figure 1

Description. Slightly preplete; hingeline straight, cardinal angles about 100°. Trilobate, L1 and S1 barely discernible, L2 broad, low, coalesced with L1; S2 deeper, straight, extending somewhat below mid height of valve, L3 broad, low. No observed cuspidal plica or velar structure. Length of figured specimen, GSC 72695, 1.8 mm, height 1.1 mm.

Type. Figured specimen, GSC 72695.

Remarks. The specimen is figured in internal view in order to show the location and depth of S2 and the presence of L2. Otherwise the valve surface is relatively plane. *Bingeria*? sp. appears somewhat similar to *B. cyamoides* Martinsson, 1962 from the Wenlock of Gotland in that the lobation of both species is extremely low, as is the velar ridge of *B. cyamoides*.

Genus *Saccarchites* Swartz and Whitmore, 1956

Type species. Saccarchites sacularis Swartz and Whitmore, 1956.

Saccarchites? sp.

Plate 3, figure 23; Plate 4, figures 9, 19, 33; Plate 17, figure 37

Description. Valves preplete, hinge straight, anterior broadly rounded, posterior margin more narrowly rounded. Lobation only indicated by shallow, indistinct depression in position of adductorial scar. Crumina a general anteroventral valve enlargement undifferentiated from the domicilium laterally, slightly overhanging free margin and with an indistinct ventral cruminal scar.

Dimensions (mm).	Length	Height
Figured specimen, GSC 72541	1.10	0.80
Figured specimen, GSC 72542	1.60	1.00

Types. Figured specimens, GSC 72541, 72542, 72699, 72705, 72840.

Remarks. It is not certain that the two heteromorphic valves are conspecific, as the size variation between them is relatively great and the configuration of their posterodorsal corners varies considerably.

Beyrichiacean indet. 1

Plate 16, figure 11

Description. One incomplete heteromorphic right valve with prominent anterior acroidal spine, indistinguishable L1 and S1, small L2, feeble S2, and L3 only partly preserved but with prominent calcarine spine. No velar or marginal ridges. Crumina large, occupying entire anterior part of valve, confluent with L1, overhanging ventral closure of the valve.

Type. Figured specimen, GSC 80887.

Remarks. It is possible that the presence of the prominent calcarine spine may indicate some generic relationship between this specimen and a generalized grouping of genera consisting at present of *Beyrichia* (*Simplicibeyrichia*) and *Beyrichia* (*Calcaribeyrichia*). The taxonomic importance of the calcarine spine is at present not known.

Beyrichiacean indet. 2

Plate 11, figures 1, 2

Description. Valves amplete; hinge long, straight, cardinal angles abrupt. Greatest length and height near mid valve, greatest width posterior of mid valve. Nonlobate, nonsulcate. Faint, near marginal velar(?) bend on both dimorphs, subcruminal on heteromorphs. Heteromorphic crumina ovate, anteroventral, extending from mid venter to above mid anterior part of valve, not overhanging margin of valve.

Dimensions (mm).	Length	Height
Figured specimen, GSC 80908	2.80	1.70
Figured specimen, GSC 80909	2.40	1.50

Types. Figured specimens, GSC 80908, 80909.

Remarks. The position of this taxon within the Beyrichiacea is not immediately apparent because of the lack of any diagnostic characteristics (except cruminal). Because of the large size of the specimens, most valves are broken; GSC 80908 is the only undoubted heteromorphic specimen observed.

Beyrichiacean indet. 3

Plate 8, figure 1

Description. Preplete, dorsal margin long, cardinal angles abrupt, posterior cardinal angle with prominent acroidal spine. Trilobate; L1 low, barely separated from L2 by an indistinct S1, L2 large, bulb-like, not reaching dorsal margin; L3 broad, separated from L2 by relatively deep, narrow S2. Velum a low, near marginal bend. L3 with 3 (or more?) prominent spines aligned anteroventrally of posterior acroidal process, possibly a supravelar row of tubercles, one of which may be in the position of the uncular spine but none in the position of the calcarine spine. Heteromorph unknown. Length of figured specimen, GSC 72708, 1.8 mm, height 1.1 mm.

Type. Figured specimen, GSC 72708.

Remarks. The figured specimen is incomplete anteriorly and has an extraneous fragment of silica adhering to L3. In lateral view the specimen resembles species of *Cornikloedenina*, but lacks the spine ventral of S2. Also, the presence of a posterior supravelar row of tubercles on L3 is unknown in species of *Cornikloedenina*.

Beyrichiacean indet. 4

Plate 4, figure 4

Description. Valve subovate, slightly flattened dorsally. Non lobate or with an area of slightly greater elevation near mid valve posterodorsal of large crumina, which is confluent with the domicilium. Velar structure a low, fine ridge parallel with the free margin and extending from posterocardinal area to beneath posteroventral part of crumina and from anterior part of crumina to anterocardinal area. Most of the ventral part of the crumina is missing. Surface of valve coarsely pitted. Length of figured specimen, GSC 72696, 1.65 mm, height 1.1 mm.

Type. Figured specimen, GSC 72696.

Remarks. The only specimen found is an incomplete heteromorphic left valve. The apparent lack of lobation might indicate its inclusion with genera of apatobolbinid affinities, but there is insufficient material on which to base this assumption.

Superfamily DREPANELLACEA Ulrich and Bassler, 1923

Family DREPANELLIDAE Ulrich and Bassler, 1923

Genus *Eoacantonodella* n. gen.

Type species. *Eoacantonodella zaspelovae* n. sp.

Diagnosis. Drepanellid? ostracodes with complete marginal ridge. Indistinctly trilobate, L1 a small dorsal node, L2 a near median lobe, L3 a long, vertical lobe somewhat dissected medially and extending above the hingeline. Horizontal lobe ventral of L2 - L3 in ventral half of valve. Area between marginal ridge and valve closure channelled. Surface irregularly to somewhat linearly reticulate.

Discussion. Zaspelova (1952) erected several new drepanellid genera from Upper Devonian strata of the Russian Platform. Two of these, *Acantonodella* and *Schweyerina* are very similar, however *Acantonodella* (as translated) is described as having "Three large nodes of various shape and size situated on the dorsal half of the valve", whereas *Schweyerina* has only two dorsal nodes. Both bear a ridge parallel with the margin and on some species of *Acantonodella* this ridge coalesces with the anterodorsal node.

As with *Acantonodella*, *Eoacantonodella* is trilobate and bears a complete, near marginal ridge. This marginal ridge does not contact L1 but continues uninterrupted to the anterior cardinal corner of the valve. Unlike *Acantonodella* and *Schweyerina*, *Eoacantonodella* bears a marked horizontal lobe ventral of L2 and L3, which may appear to continue upward anteriorly, much diminished, to near the base of the very small anterior lobe, L1. This anterior extension of the ventral lobe may be more apparent than real as the mesh-like domicilial reticulae tend to be aligned parallel with the marginal ridge.

Eoacantonodella zaspelovae n. sp.

Plate 13, figures 1-10

Description. As for the genus.

Dimensions (mm).	Length	Height
Paratype, GSC 80912	0.60	0.50
Paratype, GSC 80913	1.00	0.70
Paratype, GSC 80914	1.00	0.75
Paratype, GSC 80915	0.65	0.45
Paratype, GSC 80916	0.85	0.60
Paratype, GSC 80917	1.10	0.60
Holotype, GSC 80918	1.00	0.80
Paratype, GSC 80919	1.00	0.70
Paratype, GSC 80920	1.15	0.70
Paratype, GSC 80921	1.20	0.80

Types. Holotype, GSC 80918, paratypes, GSC 80912-80917, 80919-80921.

Genus *Kolmodinia* Martinsson, 1962

Type species. *Beyrichia grandis* Kolmodin, 1879.

Kolmodinia spinosa Copeland, 1985

Plate 8, figure 3

Kolmodinia spinosa Copeland, 1985, p. 279, Pl. 33.1, figs. 1-3.

Type. Holotype, GSC 72628.

Remarks. Only one specimen of this species has been observed, it may be a relatively juvenile form as it is much smaller than other specimens of this genus.

Kolmodinia martinssoni Copeland, 1985

Plate 11, figure 23

Kolmodinia martinssoni Copeland, 1985, p. 280, Pl. 33.1, figs. 4, 5.

Type. Holotype, GSC 80852.

Drepanellid indet. 1

Plate 14, figure 21

Description. Valve twice as long as high. Hingeline long, straight; cardinal angles abrupt, 90° or more, terminating in sharp corners. Preplete, anterior end more narrowly rounded than posterior. Complete, flaring, tubulous velar ridge. L1 a spine projecting above the hinge; L2 a hemispherical node not reaching the hinge; L3 two spines, the more ventral directed horizontally posterior of L2, the dorsal spine stronger, projecting above the hinge. Subvelar field wide, channelled. Surface of valve granular with a few pustules. Length of figured specimen, GSC 80895, 1.35 mm, height 0.7 mm (without dorsal spines).

Type. Figured specimen, GSC 80895.

Remarks. It is not without hesitation that this specimen is placed within the Drepanellidae. The lobation somewhat resembles that of *Acantonodella* or *Neodrepanella*, but the complete, flaring tubulous velum is atypical of those genera. It could be placed within the Hollinacea but dorsal spines are not typical of that group. Without additional specimens (especially if dimorphism can be shown) more exact taxonomic identification is not possible.

Drepanellid indet. 2

Plate 14, figures 20, 22

Description. Preplete, hinge straight, relatively long. Cardinal angles abrupt. Bilobate?, both lobes consisting of dorsal spinose projections extending above the hingeline and two more ventral nodes near mid height of valve, the anteroventral node slightly posterior to a line through the anterodorsal node perpendicular to the hingeline. Complete velar frill with subvelar field channelled to margin of valve. Surface granular. Length of figured specimen, GSC 80896, 0.8 mm, height 0.5 mm.

Types. Figured specimens, GSC 80896, 80897.

Remarks. This species may have some ulrichiid - bolliid characteristics in that the 4 spinose and nodose projections may represent a dissected bolliid "U", which could develop into more typically ulrichiid characteristics.

Family AECHMINIDAE Bouček, 1936

Genus *Aechminaria* Coryell and Williamson, 1936

Type species. *Aechminaria nodosa* Coryell and Williamson, 1936.

Aechminaria equalis n. sp.

Plate 5, figure 18; Plate 18, figure 19

Description. Valves amplete to slightly preplete, hingeline long, cardinal angles obtuse, free margin plain. Strong, hollow, posterodorsally directed spine, upper side of broad spine base only slightly removed from hingeline, situated slightly posterior of median in dorsal third of valve. Large, shallow pit situated anteroventral of spine base, an indistinct, rounded depression anterdorsal of spine almost at dorsal margin of valve. Valve smooth to slightly granular. No marginal or adventral features present.

Dimensions (mm).	Length	Height
Holotype, GSC 72518	1.00	0.60
Paratype, GSC 72519	1.05	0.50

Types. Holotype, GSC 72518, paratype, GSC 72519.

Remarks. This species is more nearly amplete than *A. nodosa* and *A. robusta* Coryell and Williamson, 1936. Also, in those species, the pit anteroventral of the spine base is small, deep and well defined, whereas that of *A. equalis* n. sp. is more broad and shallow. The circular depression anterodorsal of the spine base of *A. equalis* is not connected with the pit anteroventral of the spine base and may represent a sulcal feature.

Family KIRKBYELLIDAE Sohn, 1961

Genus *Kirkbyella* Coryell and Roth, 1933

Subgenus *Kirkbyella* (*Berdanella*) Sohn, 1961

Type species. Kirkbyella perplexa Wilson, 1935.

Kirkbyella (*Berdanella*) *belli* n. sp.

Plate 10, figure 26; Plate 11, figures 21, 22

Description. Valve ovate to subquadrate, slightly preplete, hingeline long. Median sulcus relatively deep, extending from dorsum to subventral lobe. Subventral lobe merging with domicilium anteriorly, produced as a spine posteriorly, ending near mid height of posterior lobe. Surface of domicilium and subventral lobe marked by fine striae, oriented horizontally in mid valve region, marginally with 4 to 6 striae parallel with free edge of valve. Length of holotype, GSC 72510, 0.8 mm, height 0.4 mm.

Types. GSC 72510, paratypes, GSC 72849, 72850.

Remarks. This early species of *Kirkbyella* (*Berdanella*) is notable in that the subventral lobe is more spinose and separated posteriorly from the domicilium for a greater length, and the longitudinal striae are more continuous and less linearly mesh-like than most species of the subgenus. *Kirkbyella* (*B.*) *belli* somewhat resembles *K.* (*B.*) *obliqua* (Coryell and Cuskley) as shown by Lundin (1968) but that species has less distinct striae and a more pronounced S2.

Superfamily HOLLINACEA Swartz, 1936

Family HOLLINIDAE Swartz, 1936

Genus *Abditoloculina* Kesling, 1952

Type species. Abditoloculina insolita Kesling, 1952.

Abditoloculina triloculata Copeland, 1977

Plate 8, figures 7, 8; Plate 10, figure 34; Plate 11, figures 3, 4

Abditoloculina triloculata Copeland, 1977, p. 28, Pl. XII, figs. 10, 11; Pl. XIV, figs. 19, 20.

Dimensions (mm).	Length	Height
Hypotype, GSC 72557	0.80	0.50
Hypotype, GSC 72558	0.90	0.70
Hypotype, GSC 72559	0.90	0.60

Types. Hypotypes, GSC 72557-72559, 80822, 80823.

Remarks. The present specimens of Wenlockian age are among the earliest known abditoloculinids yet recovered. Previously, this species was found in Delorme and Road River formations and was reported to be of Ludlovian - Gedinnian age.

Abditoloculina sp. cf. *A. triloculata* Copeland

Plate 6, figure 9

Type. Figured specimen, GSC 72709.

Remarks. This species is somewhat similar to *A. triloculata* except for the anterior lobation. Unlike *A. triloculata*, *A.* sp. cf. *A. triloculata* has the anterodorsal node extending well above the hingeline and some specimens lack the anteroventral node. Only tecnomorphic specimens have been identified, so the locular development of heteromorphic valves is unknown. Length of figured specimen, GSC 72709, 1.0 mm, height 0.7 mm.

Abditoloculina? sp.

Plate 12, figure 2

Description. Lateral outline preplete; L1 somewhat linear, parallel with anterior margin of valve and projecting above hingeline, L2 a round knob below hingeline, L3 triangular, projecting above hingeline. Sulci weak. Three sharp ridges in ventral half of valve; anterior ridge geniculate, extending from anteroventral margin of the valve to meet L1 in dorsal half of valve; median ridge short, ventral of L2, extending dorsally of ventral margin; posterior ridge slightly posteriorly inclined, ventral of L3. Complete velar ridge extending from L1 to base of anteroventral ridge and continuing as a distal velar flange to the posterior cardinal angle, with 3 shallow loculi situated beneath the distal ends of the three ventral ridges on the lateral surface. Loculi completely obscured in lateral view. Length of figured specimen, GSC 80870, 1.05 mm, height 0.8 mm.

Type. Figured specimen, GSC 80870.

Remarks. This species is somewhat similar to *A. triloculata* Copeland in that it bears three loculi and has somewhat similar dorsal lobation. The presence of ventral ridges extending onto the velar surface beneath which the loculi are hidden in lateral view is not similar to the ventral lobation and supravelar ridge present on *A. triloculata*.

Genus *Eurybolbina* Copeland, 1982

Type species. Eurybolbina krafti Copeland, 1982.

Eurybolbina sp.

Plate 3, figure 22

Description. Prepiete, hinge long, straight; cardinal angles abrupt, anterior angle more than 110°, posterior angle about 90°. Velum wide, extending from anterior cardinal angle to posteroventral part of valve where it ends abruptly in a spinose process. Wide, smooth subvelar field. Bilobate, S1 indistinct, L2 a large, low circular node and S2 deeper, extending to mid valve. Length of figured specimen, GSC 72839, 1.8 mm, height 0.95 mm.

Type. Figured specimen, GSC 72839.

Remarks. The only valve found has much adhering siliceous debris obscuring the central part of the domicilium. In interior view, however, S1 is faintly visible and S2 is readily observed as a low, curved ridge extending from the dorsum almost to mid valve.

Genus *Triemilomatella* Jaanusson and Martinsson, 1956

Type species. Triemilomatella prisca Jaanusson and Martinsson, 1956.

Triemilomatella? sp.

Plate 5, figures 5, 6

Description. Valves amplete, hingeline long, cardinal angles obtuse, rounded, free margin regularly curved. Unisulcate, S2 anterior of mid length of valve, deep, geniculate, in dorsal half of valve. Posterior lobe highest ventrally, joining anterior lobe ventral of S2. Histium? broadest anteriorly, extending from mid anterior where it joins the margin of the valve, curves in an arc to a slight constriction, extends to anteroventral corner of the valve as a hamulus, abruptly narrows along the ventral surface of the valve and terminates two-thirds along the length of the valve from the anterior end. Subhistial? area broad, limited ventrally by a thread-like marginal ridge (velar?) along the ventral part of the valve. Ventral of this ridge is a frill-like tubulous marginal structure. Surface of valve papillose. Only one dimorph known.

Dimensions (mm).	Length	Height
Figured specimen, GSC 72520	0.92	0.55
Figured specimen, GSC 72521	1.00	0.50

Types. Figured specimens, GSC 72520, 72521.

Remarks. It is not known for certain which dimorph is represented by the present specimens. The anterior arc-like curvature of the histium? is limited ventrally by a constriction and what may be a faint rib crossing the subhistial field vertical to the histium and valve margin that could be construed as forming the ventral wall of an incipient heteromorphic loculus. The abrupt differentiation of the histium? at the anteroventral corner of the valve, from a broad anteroventral hamulus to a narrow ventral ridge, is reminicent of the double histial flanges of tecnomorphs of *T. prisca* rather than the smooth continuous histial frill of heteromorphs of that species. The histium of *T.*? sp. is continuous throughout its length but is certainly not smooth.

Also, the subhistial ridge of *T.*? sp. may be marginal or velar. Whichever it is, it supports a tubulous marginal frill, with tubules inclined posteroventrally, which originates beneath the hamulus, widens posteriorly and extends at least to the ventral part of the posterior margin of the valve.

This combination of morphological characteristics does not appear to agree readily with any presently recognized hollinid genus. *Triemilomatella*? sp. is somewhat similar in age and in certain morphological aspects to *T. prisca* and is, therefore, provisionally assigned to that genus. Until the other dimorph is recognized its exact taxonomic position will be in doubt.

Genus *Billingsopsis* n. gen.

Type species. Billingsopsis planivelata n. sp.

Diagnosis. Indistinctly bisulcate hollinids with narrow, continuous histium? flaring anteroventrally in heteromorphs. No velar? structure. Anterior and posterior lobes dorsally plicate. Surface papillose.

Discussion. This genus appears to be morphologically related to certain Devonian hollinids, such as *Adelphobolbina*, in that dimorphism is expressed by the width and shape of the histium?, L2 is a broad lobe indistinctly set off from L1, and L3 is the largest lobe. *Billingsopis*, however, differs from *Adelphobolbina* in having L3 and L4 combined, and the histial? frill of *Billingsopsis* is complete, not terminating posteroventrally. It is assumed that specimens figured in Plate 5, figures 7 and 8 are heteromorphs because of the anteroventral flaring of the histium. In the same area, the histium? of tecnomorphic specimens widens somewhat but does not flare out and is smoothly continuous throughout its length.

Billingsopsis planivelata n. sp.

Plate 5, figures 7, 8; Plate 18, figure 34

Description. Valves slightly preplete in lateral view due to width of histium in the anteroventral part of the valve; indistinctly bisulcate, L1 and L2 separated by the slight swelling of L2; L3 broad, occupying entire valve posterior of the near median adductorial sulcus. Adductorial sulcus deepest ventrally, extending from dorsum to mid valve, slightly concave anteriorly. Dorsal margins of L1 and L3 lowly plicate. Histial? structure complete, extending along the free margin of the valve, widest anteroventrally (more so in heteromorphic valves) and continuing posteriorly as an indistinct ridge. Heteromorphic histium? slightly flaring in anteroventral area, constricted beneath L2, tecnomorphic histium? smoothly continuous. Subhistial? field broad, papillose, similar to lateral surface of valve. No velar? structure. Marginal structure apparently absent.

Dimensions (mm).	Length	Height
Holotype, GSC 72522	1.22	0.80
Paratype, GSC 72523	1.00	0.60
Paratype, GSC 72524	1.70	1.00

Types. Holotype, GSC 72522, paratypes, GSC 72523, 72524.

Genus *Eoflaccivelum* n. gen.

Type species. Eoflaccivelum blussoni n. sp.

Included species. Hollinella originalis Lundin, 1965; ? *Parabolbina pauxilla* Lundin, 1965.

Diagnosis. Hollinids with velar dimorphism of *Flaccivelum* type. L2 prominent, fused to L1, L1 and undifferentiated L3 merging ventral of prominent S2.

Description. Bilobate to indistinctly trilobate, posterior part of anterior lobe (L2) tending to be more prominent. Pre- and postadductorial lobation merging ventral of anteriorly concave S2. Dimorphism expressed by velar frill extending from near anterodorsal cardinal angle to mid posteroventral slope of valve, flaring slightly posteriorly, but confluent with domicilium. Velum of heteromorph posteriorly blunt, ending abruptly, somewhat undulating, and planar to slightly concave ventrally; that of tecnomorph ending posteriorly in a spinose process, evenly curved and convex ventrally. Antral area well developed between velar and marginal structures.

Species of this genus are similar to those of *Flaccivelum* Kesling and Peterson, 1958 (also see Bless and Jordan, 1971) in sulcation and velar morphology, but differ in lobal development. The prominent lobe of *Flaccivelum* species is L3, which extends to or slightly above the dorsum of the valve, whereas the prominent lobe of *Eoflaccivelum* species is L2, which is situated on the valve surface slightly ventral of the dorsal margin.

Eoflaccivelum blussoni n. sp.

Plate 8, figures 14, 15, 17-20, 23, 24;
Plate 10, figures 18-20;
Plate 11, figures 5, 6

Description. Valves preplete, hingeline long, straight, anterior cardinal angle obtuse, posterior cardinal angle about 90°. Anterior margin evenly curved to meet more sloping posterior margin. Indistinctly trilobate, L1 low, joined evenly to anterior and ventral slope of L2. L2 removed from dorsum, large, almost hemispherical in outline, forming anterior margin of anteriorly concave, prominent S2. S2 extending from dorsum to mid height of valve. L1 connected to undifferentiated postadductorial lobe ventral of S2.

Prominent velar structure confluent with domicilium, extending from near the anterior cardinal angle to mid posterior slope of valve. The velar structure originates anteriorly with the marginal structure and rises posteriorly on the valve surface. Heteromorphic velum apparently tubular, near planar, slightly undulating, ending abruptly and bluntly, posteriorly delimiting the wide antrum dorsally; tecnomorphic velum apparently plain, flaring slightly and ending posteriorly in a prominent, hollow, spinose process projecting laterally at up to 90° to the valve surface. Marginal structure a low ridge near the closure of the valve. Surface of domicilium granular.

Dimensions (mm).	Length	Height
Holotype, GSC 72545	1.20	0.60
Paratype, GSC 72546	1.05	0.50
Paratype, GSC 72547	1.40	0.80
Paratype, GSC 72548	1.60	1.00
Paratype, GSC 72549	1.60	0.85
Paratype, GSC 72550	1.60	1.00
Paratype, GSC 72551	1.70	0.90
Paratype, GSC 72552	1.40	0.80
Paratype, GSC 72553	1.30	0.70
Paratype, GSC 72554	1.60	0.90
Paratype, GSC 72555	1.70	1.00

Types. Holotype, GSC 72545, paratypes, GSC 72546 - 72555, 80910, 80911.

Remarks. Eoflaccivelum blussoni differs from *E. originalis* (Lundin) in having a more pronounced, hemispherical L2 isolated in elevation from L1, and a much more pronounced tecnomorphic velar spine.

Family SIGMOOPSIDAE

Genus *Lomatobolbina* Jaanusson, 1957

Type species. Ctenobolbina mammillata Thorslund, 1940.

Lomatobolbina? sp.

Plate 10, figure 16

Description. Hinge long, straight, cardinal angles about 100°. Unisulcate, S2 small, pit-like, near mid valve, reaching dorsal margin as a shallow depression. L2 only slightly elevated above anterior part of valve, inflated, forming a posteroventral ridge surmounted by a short, posteriorly directed spine. Marginal flange radially striate, extending from mid anterior to mid posterior margins of the valve, widest posteroventrally. Length of figured specimen, GSC 72701, 1.2 mm, height 0.7 mm.

Type. Figured specimen, GSC 72701.

Remarks. The specimen figured is somewhat similar in lateral view to the tecnomorphic specimen of *L. craspedota* Jaanusson (figured in Jaanusson, 1957, Pl. XII, figs. 10, 11) from the lower Ludibundus Limestone of Sweden, but lacks the anterior histial ridge. Also, S2 of the present species is somewhat posteriorly directed, unlike that of *L. craspedota.*

Genus *Winchellatia* Kay, 1940

Type species. Winchellatia longispina Kay, 1940.

Winchellatia berdanae n. sp.

Plate 12, figure 9

Description. Preplete, hinge long, straight. Anterior margin more narrowly curved than posterior margin. Sulcation restricted to S2, which extends from dorsal margin to near mid valve, deepest ventrally. Dorsal lobation low, even. L3 with a prominent posteroventral alate projection. Striate histial frill extending from anteroventral margin to two-thirds the distance up the posterior margin. Marginal structure finely denticulate. Surface finely granular. Length of holotype, GSC 80941, 1.2 mm, height 0.7 mm.

Type. Holotype, GSC 80941.

Remarks. As with other species of this genus, *W. berdanae* lacks a velar ridge, but unlike *W. longispina* Kay, and *W. minnisotensis* Kay, it also lacks any indication of L2. The prominent posteroventral alate lobe of L3 is somewhat similar to that of *W. lansingensis* Kay, being a sharp, ridged projection rather than spinose, similar to *W. longispina.*

Winchellatia? sp.

Plate 13, figures 27, 28

Description. Preplete, hinge long, cardinal angles obtuse. Posterior margin somewhat more broadly curved than

anterior margin. S2 narrow, long, vertical, somewhat posterior of mid valve, extending to mid valve, terminating ventrally in a pit. Histial(?) structure arising as a near marginal ridge at anteroventral part of valve, becoming more prominent posteriorly as it rises on the valve surface and terminating as an alate projection ventral of S2. No subhistial(?) structure except a marginal ridge. Surface finely tuberculate.

Dimensions (mm).	Length	Height
Figured specimen, GSC 80932	1.05	0.70
Figured specimen, GSC 80933	0.90	0.60

Types. Figured specimens, GSC 80932, 80933.

Remarks. There is no differentiation of the anterior and posterior lobes, as there is with other species of the genus. Also, the ventral spine of *Winchellatia*? sp. arises from an anteroventral ridge, whereas on most other species of the genus the spine is independent of any other structure. It is uncertain if the species is dimorphic or, if it is, which dimorph is represented by this description.

Family QUADRIJUGATORIDAE Kesling and Hussey, 1953

Genus *Kiesowia* Ulrich and Bassler, 1908

Type species. Beyrichia dissecta Krause, 1892.

Kiesowia? *decinodosa* n. sp.

Plate 8, figure 2; Plate 12, figures 29-31

Description. Moderately preplete, straight dorsum, cardinal angles somewhat obtuse. Free margin with a row of coarse spines (usually only the bases of which are preserved). Unisulcate, S2 almost median, extending to mid valve, divided dorsally by a large tubercle. Domicilium with 10 large, spinose tubercles, three along the dorsum, four median longitudinal and three parallel with the ventral margin. The mid dorsal tubercle divides S2, the two central tubercles of the median longitudinal row constrict S2 at mid valve, and S2 terminates dorsal of the median ventral tubercle. Valve surface granular. Dimorphism unknown. Length of holotype, GSC 72852, 1.15 mm, height 0.7 mm.

Types. Holotype, GSC 72852, paratypes, GSC 72556, 72851.

Remarks. Schallreuter described *Kiesowia* and its related genus *Quadritia* (*Quadritia*) Schallreuter, 1966 and *Quadritia* (*Krutatia*) Schallreuter, 1981 as quadrilobate, and based the erection of new taxa mainly on the position and total number of nodes into which the four lobes are divided, usually 8. In only one species, *Quadritia* (*Krutatia*) *tomelini* Vannier and Schallreuter, 1983 (also Vannier, 1984, p. 59, 129) are the nodes spinose similar to those of *Kiesowia*? *decinodosa* n. sp. By definition, *Quadritia* s.l. bears 4 ventral nodes and may or may not bear 4 dorsal nodes. The type species of *Kiesowia*, *Beyrichia dissecta* Krause, 1892, bears 7 nodes and some of the other species assigned to this genus are more nodose. The quesion arises as to whether number (4, 8 or more) or type (smooth, spinose) of nodes should be considered the more important taxonomic criterion. Also, the present species shows no valid evidence to indicate quadrilobation, which is more typical of species assigned to *Kiesowia* than those assigned to *Quadritia* s.l.

Superfamily OEPIKELLACEA Jaanusson, 1957

Family APARCHITIDAE Jones, 1901

Genus *Libumella* Rozhdestvenskaya, 1959

Type species. Libumella discoides Rozhdestvenskaya, 1959.

Libumella sp. cf. *L. ambigua* (Lundin), 1965

Plate 6, figures 1, 2; Plate 14, figure 26;
Plate 15, figures 8,9; Plate 17, figures 18, 19

?*Ehlersia ambigua* Lundin, 1965, p. 43, Pl. 9, fig. 2a-t; Lundin and Newton, 1970, p. 28, Pl. 1, fig. 2a.

Libumella sp. cf. *L. ambigua* (Lundin), Copeland, 1977, p. 33, Pl. I, figs. 11, 12, Pl. XII, fig. 18; Copeland, 1978a, p. 65, Pl. 11.2, figs. 19, 20; Copeland, 1978b, Pl. II, fig. 4.

Dimensions (mm).	Length	Height
Hypotype, GSC 72511	1.40	1.20
Hypotype, GSC 72512	1.30	1.10
Hypotype, GSC 72513	0.90	0.70
Hypotype, GSC 72514	1.20	1.10

Types. Hypotypes, GSC 72511-72514, 72598, 80801, 80839.

Remarks. This species is widespread throughout upper Anticosti to Ludlow strata of the District of Mackenzie and Yukon Territory. Minor variation exists in the circularity of the valves in lateral view, the size of valve reticulation, and in the preservation of the small posteroventral frill or serrations.

Libumella marginata Copeland, 1974

Plate 15, figure 7

Libumella marginata Copeland, 1974, p. 44, Pl. XIX, figs. 7-9.

Libumella marginata Copeland. Mabillard and Aldridge, 1985, p. 98, Textfig. 8.

Description. Subcircular, hinge short; faint, striate, near marginal thickening along all valve margins, anterior and posterior striate marginal frill more pronounced. Valve evenly elevated from all margins to mid valve. Surface granular with slight tendency to reticulation. Length of hypotype, GSC 80903, 1.15 mm, height 1.0 mm.

Type. Hypotype, GSC 80903.

Remarks. The presence of a striate marginal frill on the valve margins differentiates this species from other libumellids. The type specimens were collected from upper Anticosti strata of the upper Jupiter and lower Chicotte formations along the southern coast of Anticosti Island, Québec. Mabillard and Aldridge (1985) report this species in uppermost Llandovery and basal Wenlock strata from the type section of the Wenlock Series near Wenlock Edge, Shropshire (herein, addendum number 3). This would appear to lend support to a previous assumption (Copeland, 1982a) that all of the Lower Silurian may be present in the type area of the Anticosti Series, Anticosti Island, Québec.

Libumella sp. indet.

Plate 3, figures 27, 31; Plate 4, figures 3, 5; Plate 10, figure 33

Description. Subcircular, hinge short, faint marginal thickening along all valve margins slightly overhanging hinge dorsally. Surface smooth to slightly granular, greatest elevation slightly anterior(?) of mid valve.

Dimensions (mm).	Length	Height
Figured specimen, GSC 72516	1.50	1.20
Figured specimen, GSC 72515	1.55	1.20

Types. Figured specimens, GSC 72515, 72516, 72704, 72844.

Remarks. This species is more laterally elevated than *Libumella* sp. Copeland, 1977, and more regularly subcircular than *L. discoides* Rozhdestvenskaya, 1959. The hingement (Pl. 10, fig. 33) of a left(?) valve apparently comprises terminal sockets and an intervening groove.

Libumella? *cardinalis* n. sp.

Plate 4, figure 25; Plate 6, figure 3

Description. Valve circular in lateral view, rising gently from all margins to mid valve. Cardinal angles(?) marked by two small, cardinal projections above either end of the short, simple hinge. Marginal structure consisting of a fine, tuberculate ridge near and parallel with the valve closure; marginal ridge contacting the dorsal alae and continuing parallel to the slightly incised hinge. Valve surface smooth to granular. Length of holotype, GSC 72562, 1.8 mm, height 1.7 mm.

Types. Holotype, GSC 72562, paratype, GSC 72682.

Remarks. The smooth to slightly granular valve surface and fine marginal and dorsal ridges of this species are similar to that of *L. circulata* Rozhdestvenskaya, 1962. The presence of two short dorsal cardinal projections, however, is more distinctive and consequently the inclusion of this species within *Libumella* is questioned.

Libumella? sp. 1

Plate 17, figure 21

Description. Subovate, postplete(?), right(?) valve overlapping left ventrally with left(?) overlapping right dorsally. Hinge short, straight. Valves with narrow rim around free margins. Lateral surface finely reticulate, rising evenly from margins to greatest elevation near mid valve. Length of figured specimen, GSC 72657, 1.4 mm, height 1.1 mm.

Type. Figured specimen, GSC 72657.

Remarks. This species is more ovate and posteriorly? planate than *L.* sp. cf. *L. ambigua* (Lundin) and *L.* sp. indet. of this report, and is intermediate in ornamentation between those species, and is not as highly elevated laterally as *L.* sp. indet. The ventral-dorsal reversal of overlap is not reported for other species of the genus.

Superfamily PRIMITIOPSACEA Swartz, 1936

Family PRIMITIOPSIDAE Swartz, 1936

Genus *Undulirete* Martinsson, 1964

Type species. Undulirete balticum Martinsson, 1964.

Undulirete mackenziensis Copeland, 1977

Plate 9, figures 17, 19, 23, 27; Plate 15, figures 20-27

Undulirete mackenziensis Copeland, 1977, p. 36, Pl. X, fig. 5; Pl. XIV, figs. 1, 2, 11; Copeland, 1978, p. 65, Pl. 11.1, fig. 6.

Dimensions (mm).	Length	Height
Hypotype, GSC 72487	0.70	0.50
Hypotype, GSC 72488	0.90	0.50
Hypotype, GSC 72489	0.80	0.50
Hypotype, GSC 72490	0.90	0.50

Types. Hypotypes, GSC 72487-72490, 72599, 72600, 72602-72604, 80799, 80800.

Remarks. The present specimens are better preserved than any previously figured. The regular alignment of the rounded reticulae and the drop-shaped adductorial sulcus and internal scar are well demonstrated. The number of posterior velar spines appears to vary from 4 to 8. It is still not possible to determine if there are dimorphs in this species.

Undulirete? sp.

Plate 3, figure 21

Description. Hinge apparently short (specimen broken dorsally); cardinal angles rounded, obtuse. Free margin evenly rounded. Velar ridge complete, encircling entire lateral surface of valve. The presence or absence of a dorsal crest is not known. S2 a round to tear-shaped pit at about one-third the greatest length of the valve. Subvelar surface of valve broad, at right angles to the domicilial surface. Valve surface granular. Length of figured specimen, GSC 72838, 1.4 mm, height 1.1 mm.

Type. Figured specimen, GSC 72838.

Remarks. This species lacks the reticulate surface and posterior velar spinosity of *U. mackenziensis* Copeland and is appreciably larger than specimens of that species. Only tecnomorphic specimens have been observed, so the presence of a heteromorphic posterior pouch is unknown.

Genus *Venzavella* Gailite, 1967

Type species. Limbinaria costata Neckaja, 1960.

Venzavella? sp.

Plate 5, figures 3, 4; Plate 13, figure 11

Description. Valves ovate in lateral view with complete velar ridge continuous with dorsal plica. Hinge straight, sunken. Marginal and velar ridges separated by subvelar furrow. S2 long, not pit-like, extending from dorsal plica to

median ridge. Valve surface traversed by two horizontal ridges, the more dorsal of which is slightly ventral of mid valve, extending across the valve from mid anterior to mid posterior margin. The more ventral ridge is in ventral third of valve, extending from anterior margin two-thirds the length of valve.

Dimensions (mm).	Length	Height
Figured specimen, GSC 72543	0.80	0.40
Figured specimen, GSC 72544	0.90	0.50

Types. Figured specimens, GSC 72543, 72544, 80922.

Remarks. These specimens, somewhat incomplete posteriorly, are considered to be tecnomorphic. The presence of only two lateral ridges, a high dorsal plica and a relatively long, thin S2 distinguish these specimens from other previously described species of *Venzavella*.

Genus *Polenovula* Martinsson, 1960

Type species. Leperditellina(?) *crassa* Polenova, 1955.

Polenovula rara n. sp.

Plate 11, figures 13, 14; Plate 18, figure 35

Description. Large, smooth polenovulid species with barely discernible sulcoid depression, L2 node very low. Dolonal pouch large, closed, occupying entire posterior margin of valve, set off from the domicilium in lateral view. Domicilium of tecnomorphic valve similar to that of heteromorph; tecnomorphic velar structure broad, flaring posteriorly and continuing anteriorly on the domicilium to near mid ventral area of right valve and as low ridge to the anterior part of the left valve. Broad, tubulous sub velar marginal flange along mid venter of tecnomorphic specimens. Length of holotype, GSC 72507, 1.3 mm, height 0.7 mm (specimen now broken anteroventrally).

Types. Holotype, GSC 72507, paratypes, GSC 80855, 80856.

Remarks. This species is somewhat similar to *P. recta* Gailite, 1966 but *P. rara* has a faint sulcoid depression that is not present on *P. recta*; also, the velar structure on tecnomorphic valves of *P. rara* is most distinctive.

Genus *Limbinariopsis* n. gen.

Type species. Limbinariopsis sinuata n. sp.

Diagnosis. Non lobate, non sulcate. Domicilium surrounded by a pronounced, sinuous lateral plica. Ventral structures of heteromorphs with a wide tubulous velum anterior of a wide, flat, posterior velar flange (chamber).

Discussion. This genus is most closely related to *Limbinaria* in having a distinct, narrow plica surrounding the domicilium and a broad, flat posterior velar flange. Unlike *Limbinaria*, *Limbinariopsis* has no sulcation and possesses a tubulous anteroventral velum.

It does not seem logical to continue to subdivide the Family Primitiopsidae into the sulcate subfamily Primitiopsinae and the nonsulcate Family Leiocyaminae. The genus described here, *Limbinariopsis*, is completely nonsulcate, does not bear a sulcal pit and is closely related to *Limbinaria*, a primitiopsine genus. In this volume, the Family Primitiopsidae is retained without subfamilial designation.

Limbinariopsis sinuata n. sp.

Plate 5, figures 1, 2

Description. Limbinaria-like primitiopsid with a sinuous lateral plica extending from near mid venter, along the posterior of the domicilium and across the dorsum (undulating near mid dorsum) to anterior cardinal angle. From the anterior cardinal angle to mid anterior of the valve, the plica is interrupted by a series of small spinules. At mid anterior of the valve, the plical ridge reappears, crossing the anteroventral and ventral margins of the valve ventral of the ventral end of the plica and curves ventrally to form the anterior margin of the wide, flat to flaring posterior velar flange (chamber). A strong, tubulous velum is developed anterior of the chamber and ventral of the plica. This velar structure probably extends to near the anterodorsal cardinal angle and is there represented by the anterodorsal spinules.

Within the area enclosed by the plica, the valve surface undulates slightly but is unornamented except for having a granular appearance. The posterior velar flange (chamber) is wide, has the same somewhat granular appearance as the domicilial surface and is flat, except in its distal portion, which is slightly flaring.

Dimensions (mm).	Length	Height
Paratype, GSC 72636	1.20	0.80
Holotype, GSC 72637	1.10	0.80

Types. Holotype, GSC 72637, paratype, GSC 72636.

Primitiopsid? indet.

Plate 14, figures 23-25

Description. Carapace elongate, slightly preplete, twice as long as high. Hinge long, straight, depressed between fine dorsal carinae. Surface smooth to granular with circular muscular spot or depression near mid valve. Velum thread-like, extending from mid anterior to mid posterior, somewhat removed from venter. Subvelar ridge papillose, extending from posterior cardinal angle along two-fifths of the ventral margin, diverging from complete marginal ridge.

Dimensions (mm).	Length	Height
Figured specimen, GSC 80836	1.30	0.70
Figured specimen, GSC 80837	1.25	0.70
Figured specimen, GSC 80838	1.40	0.70

Types. Figured specimens, GSC 80836-80838.

Remarks. All of the specimens studied appear to be tecnomorphic, making the taxonomic placement of the species difficult. The presence of a posteroventral subvelar ridge is a feature present on many primitiopsids.

Family PRIBYLITIDAE Pokorny, 1958

Genus *Pribylites* Pokorný, 1950

Type species. Pribylites moravicus Pokorný, 1950.

Pribylites? sp.

Plate 3, figure 26

Description. Valve subtriangular, hinge long, straight. Free margins evenly curved to greatest height at mid valve. Cardinal angles abrupt. Velar? structure a narrow ridge extending from mid posterior margin to mid anterior margin. Surface granular. Length of figured specimen, GSC 72843, 1.05 mm, height 0.8 mm.

Type. Figured specimen, GSC 72843.

Remarks. This species is somewhat similar to *P. bimarginatus* (Neckaja) in lateral view, but the velar? structure of that species is farther removed from the margin of the valve. As with *P. bimarginatus* the specimen of *Pribylites*? sp. described here may have a faint indication of S2.

Superfamily LEPERDITELLACEA Ulrich and Bassler, 1906

Family LEPERDITELLIDAE Ulrich and Bassler, 1906

Genus *Primitiella* Ulrich, 1894

Type species. Primitiella constricta Ulrich, 1894.

Primitiella sp. 1

Plate 13, figure 17

Description. Elongate, oval, with imperceptible cardinal angles and possible slight depression near mid length of valve. L/R overlap. Surface finely punctate. Length of figured specimen, GSC 80934, 1.1 mm, height 0.65 mm.

Type. Figured specimen, GSC 80934.

Remarks. This is a very generalized leperditellid that occurs commonly throughout the Avalanche Lake sections.

Primitiella sp. 2

Plate 3, figure 20

Description. Hinge long, straight, free margins evenly curved, anterior more narrowly than posterior. Faint indication of S2 anterior of low dorsal hump of valve. Surface granular. Length of figured specimen, GSC 72837, 2.1 mm, height 1.3 mm.

Type. Figured specimen, GSC 72837.

Remarks. The specimen figured is rather large when compared with other species of the genus. It is the largest observed; others referred to the same taxon are mostly broken.

Superfamily KLOEDENELLACEA Ulrich and Bassler, 1923

Family KLOEDENELLIDAE Ulrich and Bassler, 1908

Genus *Dizygopleura* Ulrich and Bassler, 1923

Type species. Dizygopleura swartzi Ulrich and Bassler, 1923.

Dizygopleura? *borealis* n. sp.

Plate 5, figure 15; Plate 10, figures 29-31; Plate 17, figures 8, 9, 15

Description. Valves elongate, twice as long as high. Hinge long, straight, hidden in posterior half of valve by dorsal extension of L2 - L3. Left valve overlapping right valve at rounded dorsal cardinal angles and along slightly concave mid venter. Lobation sinuous, low, forming a recumbent "S"; L1 extending from dorsum to near venter, curving beneath S2 to join oblique L2 which, in turn, joins L3 above the hinge in the posterior half of the valve. L3 extending to near posterior ventral corner of the valve. Surface granular.

Dimensions (mm).	Length	Height
Holotype, GSC 72617	1.30	0.60
Paratype, GSC 72618	1.25	0.60
Paratype, GSC 72519	1.30	0.60

Types. Holotype, GSC 72617, paratypes, GSC 72618-72620, 72639, 72640, 72649.

Remarks. This species has very low lobation apparently of *D. swartzi* type; consequently the sulcation is indistinct. Unlike *D. swartzi* the valve anterior of L1 slopes gently toward the anterior margin. The left valve curves smoothly to overlap the right along the cardinal angles, but the overlap is not angular to the extent that a typical stragular process is developed. Because of the lack of a well defined stragular process, the species is questionably referred to *Dizygopleura*. It is not certain whether dimorphic specimens occur in the present collections; GSC 72619 (a valve) may be proportionately narrower than the other figured specimens, but most of the latter are carapaces and comparison is difficult.

Superfamily PARAPARCHITACEA Scott, 1959

Family PARAPARCHITIDAE Scott, 1959

Genus *Rozhdestvenskayites* McGill, 1966

Type species. Rozhdestvenskayites diuturna McGill, 1966.

"Rozhdestvenskayites" sp. cf. *"R " auriculiferus* (Rozhdestvenskaya), 1962

Plate 10, figure 21

Aparchites auriculiferus Rozhdestvenskaya, 1962, p. 171, 172, Pl. 1, figs. 1a, b, 2a, b.

Rozhdestvenskayites auriculiferus (Rozhdestvenskaya). McGill, 1966, p. 112.

"Aparchites" sp. aff. *"A." auriculiferus* Rozhdestvenskaya. Berdan and Copeland, 1973, p. 28, 29, Pl. 10, figs. 13, 14.

"Rozhdestvenskayites" cf. *"R." auriculiferus* (Rozhdestvenskaya). Stone and Berdan, 1984, p. 998, fig. 9A, B.

Type. Hypotype, GSC 72674.

Remarks. For a discussion of this taxon see Stone and Berdan (1984, p. 999). In his remarks concerning the genotype, *R. diuturna*, McGill (1966, p. 112) stated that on "the carapace of *Rozhdestvenskayites* n. gen. . . . there is no marginal ridge or submarginal groove. The ventral margin of

both valves is smooth and unornamented." Examination of the holotype (GSC 17364), however, shows that whereas the ventral margin of each valve bears no discernible ridge (as in *Aparchites*) it is somewhat thicker than the general latero-ventral curvature of the valve and presents a slight indication of a smooth marginal structure. The present specimens, those from the McCann Hill Chert of Alaska and Roberts Mountain Formation of Nevada, or (as described) the type material from the U.S.S.R. do not have marginal thickening of the valves. Whether this feature distinguishes them from *Rozhdestvenskayites* s.s. is not clear. Length of the figured specimen, GSC 72674, 1.65 mm, height 1.3 mm.

Rozhdestvenskayites? sp.

Plate 15, figures 18, 19; Plate 18, figures 30, 31

Description. Species known from numerous valves. Hinge long, straight, cardinal angles abrupt, somewhat auriculate. Free margin relatively evenly curved, anterior and posterior margins more narrowly curved than venter. Surface smooth, rising evenly from all margins. No marginal ridge or marginal thickening.

Dimensions (mm).	Length	Height
Figured specimen, GSC 80936	1.60	1.10
Figured specimen, GSC 80937	1.45	1.10

Types. Figured specimens, GSC 72688, 72689, 80936, 80937.

Remarks. This species is somewhat similar to "*R.*" cf. "*R.*" *auriculiferus* (Rozhdestvenskaya, 1962) and "*R.*" sp. figured by Stone and Berdan (1984, Figs. 9A-D) but is not as high and has a longer hingeline. Generic designation of any of these species as *Rozhdestvenskayites* is questionable (see discussion in Stone and Berdan, 1984, p. 1000).

Genus *Tipperopsis* n. gen.

Type species. Tipperopsis quadrilineata n. sp.

Diagnosis. Paraparchitid? ostracodes with rounded cardinal angles, central muscle spot and vertical linear ornamentation.

Remarks. This genus is erected to include aberrant paraparchitid? species that bear lateral ornamentation of nonsulcal/nonlobal origin and lack a marginal ridge or submarginal groove. The presence of domicilial ornamentation is so unusual in this family that it is not possible to compare the specimens with any previously erected genus.

Tipperopsis quadrilineata n. sp.

Plate 6, figure 8; Plate 16, figures 6, 7

Description. Valves nearly circular in outline, somewhat preplete. Slightly flattened dorsally in position of hinge. Valve surface finely granular, rising abruptly from all margins. Four long, equally spaced, unconnected, low, vertical ridges present in the area of greatest elevation. Circular muscle scar present at mid valve between and slightly deflecting ridges 2 and 3. No marginal structure. Length of holotype, GSC 72563, 1.45 mm, height 1.2 mm.

Types. Holotype, GSC 72563, paratypes, GSC 72601 (unfigured), 80831, 80832.

Superfamily indet.

Genus *Alaskabolbina* Berdan and Copeland, 1973

Type species. Alaskabolbina unilineata Berdan and Copeland, 1973.

Alaskabolbina trinodosa n. sp.

Plate 5, figures 9-14;
Plate 9, figures 21, 22, 24, 25, 28, 29;
Plate 11, figure 10; Plate 18, figures 37, 38

Description. Lateral outline slightly preplete. Large hemispherical median node at mid height of domicilium. Massive, crested antero- and posterodorsal cusps protrude above hingeline. Domicilial surface and nodes coarsely reticulate. Tubulous velar flange from anterodorsal angle to or nearly to posterodorsal angle, widest ventrally, at an extreme angle to the domicilium. Subvelar field wide, forming a right angle at its juncture with the domicilium at the velar flange. Specimens with a weak toric ridge at the base of the velar flange (subvelar) or with no such ridge.

Measurements of figured specimens are shown below. There is great variation in measurements of the figured specimens. Heteromorphs, in particular, may have velar flanges that project laterally from 30 to 70 degrees from the domicilial wall. Therefore, the height measurements from the top of the dorsal nodes to the dorsal edge of the velar flange where it joins the domicilium are given as well as the overall height to the outer edge of the velar flange. In effect, this lateral domicilial height approximates the height across the interior of the valve from the top of the dorsal nodes to the ventral point of closure of the valves.

Dimensions (mm).	Length	Height	Height of domicilium
Paratype, GSC 72492	1.40	0.80	0.55
Holotype, GSC 72493	1.30	0.60	0.50
Paratype, GSC 72494	0.90	0.55	0.50
Paratype, GSC 72495	0.90	0.70	0.55
Paratype, GSC 72496	1.60	0.90	0.60
Paratype, GSC 72497	0.75	0.50	0.45
Paratype, GSC 72498	1.20	0.70	0.60
Paratype, GSC 72499	1.30	0.50	0.50
Paratype, GSC 72500	1.10	0.55	0.50
Paratype, GSC 72501	1.30	0.60	0.40
Paratype, GSC 72502	1.15	0.60	0.55
Paratype, GSC 72503	1.55	0.70	0.60
Paratype, GSC 72504	1.35	0.55	0.50
Paratype, GSC 72505	1.80	0.90	0.60

Types. Holotype, GSC 72493, paratypes, GSC 72492, 72494-72505, 80857.

Remarks. This species is most similar to *Alaskabolbina paucilineata* Copeland, 1977 from the Road River Group, but the reticulae of the present species are more distinct, the dorsal nodes are crested and knob-like and the valves are ovate in lateral view, not semicircular.

Alaskabolbina? sp.

Plate 12, figure 19

Description. Preplete, hinge long, straight; free margin evenly curved. Complete, broad, near marginal, striate frill.

Trilobate, L1 and L3 projecting above hinge, pointed rather than crested; L2 a prominent rounded node slightly anterodorsal of mid valve. Surface finely granular. Approximate measurements of damaged right valve: length 1.05 mm, height 0.6 mm.

Type. Figured specimen, GSC 80945.

Remarks. This species may be compared with *Alaskabolbina* sp. of Stone and Berdan in having pointed rather than crested anterior and posterior lobes and a pronounced, rounded, near median node.

Genus *Yukonibolbina* Copeland, 1977

Type species. Yukonibolbina plana Copeland, 1977.

Yukonibolbina? sp. 1

Plate 9, figure 26; Plate 12, figure 10

Description. Preplete, finely granular domicilium with only slight indication of a near median adductorial fold. Broad, tubulous, incurved velar flange. Subvelar field apparently smooth. Length of figured specimen, GSC 72506, 2.05 mm, height 1.1 mm.

Types. Figured specimens, GSC 72506, 80872.

Remarks. This is a large *Yukonibolbina* species. The specimens are incomplete. The posterior velar flange and ventral margin are broken, so the presence of a posteroventral velar spine and possible subvelar torus are not known.

Berdan (1986, p. 371) discussed the relationships of *Yukonibolbina*, *Alaskabolbina* and *Praepaegnium*, for which no heteromorphs are presently known, with *Eurekabolbina* Berdan, 1986 and *Ampletochilina* Schallreuter, 1969, which possess dolonal dimorphism and are, accordingly, assigned by Berdan to the Eurychilinacea. Because tecnomorphs of species of these five genera are somewhat similar morphologically, Berdan (1986, p. 371) suggests that "when heteromorphs are found, they will probably have dolonal dimorphism."

Yukonibolbina? sp. 2

Plate 4, figure 15

Description. Hinge long, straight; cardinal angles abrupt. Nonlobate, nonsulcate; surface smooth. Velar flange smooth, extending from anterior cardinal angle, flaring anteriorly, but planar and increasing in width posteriorly, extending laterally as a flange and terminating abruptly posteroventrally as an acute spine. Subvelar field smooth. Length of figured specimen, GSC 72683, 1.4 mm, height 0.9 mm.

Type. Figured specimen, GSC 72683.

Remarks. Only the ventral view of the specimen is illustrated; the posterior portion of the velum shows only as a continuation of the unornamented domicilium in lateral view. The increased width of the velum is apparent as is its abrupt posterior termination. This type of velar flange is not typical of other species of the genus, so placement of the species within *Yukonibolbina* is tenuous.

Genus *Delormobolbina* n. gen.

Type species. Delormobolbina binodosa n. sp.

Diagnosis. Palaeocope ostracodes with central bulb (L2?) posterocentral node (L3?), anterior ridge (L1?) and posterodorsal and anterodorsal cusps or spines. Velum tubulous, complete. Domicilium ornamentation pustulose. Row of pustules (torus?) on subvelar field parallel to free margin. Heteromorph not known with certainty.

Discussion. The tubulous velum of *Delormobolbina* suggests beyrichiid or eurychilinid affinities, but until heteromorphs are recognized, the systematic position and relationship of this genus cannot be determined. The conspicuous bulb occupies the position of L2 in beyrichiacean ostracodes, and the dorsal cusps are reminiscent of *Alaskabolbina* Berdan and Copeland, but the posterocentral node (L3?), anterior ridge (L1?) and complete velar structure are not present in species of that genus. For descriptive purposes it seems desirable to consider *Delormobolbina* as a possibly sulcate ostracode with S1 separating L1 and L2, and S2? separating L2 and L3. Both sulci(?) joining dorsally and separating the dorsal cusps. On the interior, however, the depressed central bulb and posterocentral node are clearly visible, but the surrounding sulci(?) are not visibly elevated above the general internal valve surface.

One specimen of *D. binodosa* (Pl. 11, fig. 11) bears a wider, slightly concave velum, whereas the remaining specimens have narrower, somewhat concave vela. Whether this may be considered a dimorphic characteristic is presently unknown.

Delormobolbina binodosa n. sp.

Plate 11, figures 7-9, 11, 12

Description. Valve preplete; hinge long and straight, hidden beneath prominent dorsal cusps. Both cardinal angles more than 90°. Central part of valve with a prominent hemispherical bulb (L2?) and less prominent posterocentral node possibly in the postion of L3(?). Anterior lobe a sharp ridge concave posteriorly that extends from beneath the prominent anterior dorsal cusp to beneath the central bulb. Dorsal cusps crescentic, extending from above dorsum parallel with anterior and posterior margins to slightly above mid height of valve.

Velar structure complete, tubulous, possible tecnomorphs with narrower velum flaring outward slightly; possible heteromorphs (Pl. 11, fig. 11) with wider velum convex outward. Subvelar field with a row of tubercles (torus?) parallel to prominent marginal ridge. Domicilial surface pustulose.

Dimensions (mm).	Length	Height
Paratype, GSC 80858	1.05	0.70
Paratype, GSC 80859	1.00	0.70
Paratype, GSC 80860	1.10	0.70
Paratype, GSC 80861	1.25	0.80
Holotype, GSC 80862	1.00	0.70

Types. Holotype, GSC 80862, paratypes, GSC 80858-80861.

Genus *Signetopsis* Henningsmoen, 1954

Type species. Signetopsis quadrilobata Henningsmoen, 1954.

Signetopsis reticulata n. sp.

Plate 9, figure 20; Plate 13, figure 16

Description. Bilobate?, entire surface reticulate. S2 deep, pit-like with small L2?. Anterior lobe? hidden beneath pronounced, high, comma-shaped ridge that is widest near the anterior cardinal angle, crosses mid valve and posterior lobe parallel with free margin, curves parallel with dorsum and, diminishing slightly in height, meets itself near the anterior cardinal angle, enclosing the dorsal half of the valve. Velar flange complete, posteriorly with a row of small spines, more sharply folded but not as high as the comma-shaped ridge, which it joins at the cardinal angles. Subvelar field reticulate. Dimorphism may be expressed by the posterior height of the velar flange. Length of holotype, GSC 72491, 0.8 mm, height 0.6 mm.

Types. Holotype, GSC 72491, paratype, GSC 80927.

Remarks. This species somewhat resembles *Signetopsis semicircularis* (Krause), 1891, but the comma-shaped ridge of *S. reticulata* n. sp. curves to form a closed oval rather than a bolliid "U" as in *S. semicircularis*.

Palaeocopid indet. 1

Plate 8, figure 16

Description. Valve slightly preplete, hinge long, cardinal angles abrupt, about 90°. Lobate, L1 with a short anterodorsal ridge extending above the hinge and a small ventral, conical node anterior of the ventral portion of L2; L2 prominent, hemispherical, separated from L1 by a relatively deep S1 and from L3 by a prominent S2; L3 broad, with a prominent, vertical, anterior ridge extending slightly above the hinge in lateral view and a separate posterior dorsal cusp (L4?). L2 and L3 confluent with ventral part of domicilium. Complete, broad, tubulous, flaring velum with subvelar channel and marginal ridge. Length of figured specimen, GSC 72706, 1.2 mm, height 0.7 mm.

Type. Figured specimen, GSC 72706.

Remarks. Whether this specimen is a drepanellid or hollinid is uncertain. It bears some resemblance to the drepanellids described by Zaspelova (1952) from the Upper Devonian, at least one genus of which may be questionably assigned to the Hollinacea.

Palaeocopid indet. 2

Plate 4, figure 10

Description. Amplete; hinge long, nearly equal to greatest length; cardinal angles abrupt, slightly greater than 90°. Trilobate, L1 and L3 low, L2 a poorly defined node near mid valve. S1 indistinguishable, S2 broad, very shallow. Lateral structure a double row of denticles orginating at the anterior cardinal angle, rising on the surface of the domicilium (especially near mid venter), extending to mid posterior of the valve. The more dorsal row of denticles curves abruptly at mid posterior and crosses the domicilium to terminate at the hingeline above S2; the ventral row of denticles extends dorsally from the mid posterior area, joins the faint marginal ridge and terminates at the posterior cardinal angle. Where the lateral structures are in close proximity there may be connecting partitions. Length of figured specimen, GSC 72698, 1.4 mm, height 0.8 mm.

Type. Figured specimen, GSC 72698.

Remarks. It is possible that the lateral denticulate ridges could represent a thick, tubulous velar? or histial? ridge that has been broken near the domicilial surface. This explanation would be valid only where the rows of denticles are in close proximity, but not where the ridges diverge posteriorly and posterodorsally. A relationship with certain, mainly Ordovician, hollinacean genera may be a remote possibility.

? Palaeocopid indet. 3

Plate 12, figures 3, 4

Description. Preplete, non-lobate, non-sulcate ostracode species with irregular lateral outline in lateral view. Internally, the domicilium represents about three-fourths of the area of the valve, the thick valve wall extending distal of the straight hinge and free margin from the anteroventral corner to the posterior cardinal angle, especially prominent posteriorly. The valve extension marked internally by several sharp ridges approximately at right angles to the free margin of the valve. Length of figured specimen, GSC 80871, 0.8 mm, height 0.6 mm.

Type. Figured specimen, GSC 80871.

Remarks. This enigmatic form is of unknown affinity, except that the straight hingeline probably indicates its placement within the Palaeocopida. The extreme thickness of the unornamented valve wall may give rise to conjecture that the external surface of the valve is obscured by adhering silica, but there is no apparent evidence from internal examination to support such a conclusion.

Order PODOCOPIDA Müller, 1884

Suborder PODOCOPINA Sars, 1886

Superfamily BAIRDIACEA Sars, 1888

Family BAIRDIIDAE Sars, 1888

Genus *Processobairdia* Blumenstengel, 1965

Type species. Processobairdia anterocerata Blumenstengel, 1965.

Processobairdia delormensis Copeland, 1977

Plate 5, figure 16; Plate 18, figure 4

Processobairdia delormensis Copeland, 1977, p. 38, Pl. II, fig. 15; Pl. III, figs. 1-7; Copeland, 1978, Table 11.1, Pl. 11.2, figs. 16-18.

Dimensions (mm).	Length	Height
Hypotype, GSC 72616	1.15	0.70
Hypotype, GSC 72536	2.30	1.10

Types Hypotypes, GSC 72616, 72536.

Remarks. This species appears to be widespread in the Yukon Territory and District of Mackenzie. It occurs in both the Road River Group and Delorme Formation in strata of Wenlock - Ludlow age.

Genus *Newsomites* Morris and Hill, 1952

Type species. *Newsomites pertumidus* Morris and Hill, 1952.

Newsomites inequalis n. sp.

Plate 17, figures 13, 32, 33, 36

Description. Valves turnid, carapaces as wide as high. Hinge sunken between dorsal humps of both valves. Anterior margin, more broadly curved than posterior margin, which is bluntly rounded in its dorsal part in bairdian fashion. L/R valve overlap pronounced all around free margins and along the dorsum. Anterior and posterior margins somewhat compressed, venter relatively flat.

Dimensions (mm).	Length	Height
Paratype, GSC 72651	1.00	0.50
Paratype, GSC 72652	1.10	0.50
Paratype, GSC 72653	1.00	0.50
Holotype, GSC 72654	1.00	0.50

Types. Holotype, GSC 72654, paratypes, GSC 72651-72653.

Remarks. This species differs from other Silurian species of the genus in having the pronounced central dorsal hump of the valves somewhat compressed between lower, but obvious, bluntly rounded dorsal cardinal areas. Also, the line of greatest length of the valves is horizontal to the venter rather than inclined. Only carapaces have been observed so that internal structures are unknown.

Genus *Spinobairdia* Morris and Hill, 1952

Type species. *Spinobairdia kellettae* Morris and Hill, 1952.

Spinobairdia dorsicornis Copeland, 1977

Plate 17, figure 34; Plate 18, figures 15, 16, 18

Spinobairdia dorsicornis Copeland, 1977, p. 38, Pl. IV, figs. 20, 21.

Dimensions (mm).	Length	Height
Hypotype, GSC 72655	1.50	0.80
Hypotype, GSC 72629	1.90	0.90
Hypotype, GSC 72630	1.70	0.90
Hypotype, GSC 72631	1.80	0.90

Types. Hypotypes, GSC 72629-72631, 72655.

Genus *Bairdiacypris* Bradfield, 1935

Type species. *Bairdiacypris deloi* Bradfield, 1935.

Bairdiacypris? subarctica Copeland, 1977

Plate 17, figure 4

Bairdiacypris? subarctica Copeland, 1977, p. 37, Pl. XIII, fig. 8.

Type. Hypotype, GSC 72643.

Bairdiacypris? sp.

Plate 4, figure 27; Plate 18, figure 9

Types. Figured specimens, GSC 72681, 72635.

Remarks. Not as dorsally elevated as *B.? subarctica* Copeland 1977, only valves have been recognized, so overlap not known.

Family BEECHERELLIDAE Ulrich, 1894

Genus *Acanthoscapha* Ulrich and Bassler, 1923

Type species. *Beecherella navicula* Ulrich, 1891.

"*Acanthoscapha*" *dorsiglobosa* n. sp.

Plate 15, figures 1-3; Plate 17, figure 10

Description. Valves strongly preplete, cardinal angles with pronounced prolongation in the plane of the hinge. Anterior and posterior thirds of valve slightly elevated, median third pronouncedly elevated as a globular area from near ventral margin and extending above the hinge, slightly more elevated dorsally. Surface smooth. Length of holotype, GSC 72585, 1.5 mm, height 0.5 mm.

Types. Holotype, GSC 72585, paratypes, GSC 80828-80830.

Remarks. This species is more highly elevated medially and dorsally than other species of the genus [i.e. *A. subnavicula* Abushik and *A.* sp. cf. *A. decurtata* (Bouček)]. There may well be considerable variation within this group of species but this is unknown at present.

"*Acanthoscapha*" *dorsicornis* n. sp.

Plate 5, figure 21

Description. Valves preplete, cardinal angles with pronounced prolongation in the plane of the hinge. Valves slightly elevated to mid point. Mid dorsum extended as a low, pointed elevation above the sunken hinge. Surface granular. Length of holotype, GSC 72586, 1.5 mm, height 0.5 mm.

Type. Holotype, GSC 72586.

Remarks. This species of "*Acanthoscapha*" differs from those previously described in having the dorsal elevation produced into a low, pointed node, unlike the more gentle dorsal curvature of *A. decurtata* (Bouček) and *A. subnavicula* Abushik or the globular dorsum of "*A.*" *dorsiglobosa*. Whether "*A.*" *dorsicornis* n. sp. is a true acanthoscaphid is open to question as the parentheses indicate.

Acanthoscapha sp. cf. *A. decurtata* (Bouček), 1936

Plate 5, figure 20; Plate 17, figure 16;
Plate 18, figures 23, 28

?*Alanella bohemica* var. *decurtata* Bouček, 1936, p. 72, Pl. V, fig. 1a, b; Pl. VI, fig. 2 (not *A. decurtata* Bouček. Bouček and Příbyl, 1955, Pl. 78, figs. 9a, b, 10a, b).

?*Alanella decurtata* Bouček. Kesling and Sohn, 1958, p. 522, Pl. 78, figs. 18, 19.

?*Acanthoscapha decurtata* (Bouček). Berdan, 1960, p. 471, 473.

Acanthoscapha sp. cf. *A. decurtata* (Bouček). Copeland, 1977, p. 40, Pl. III, figs. 10-12; Pl. XV, fig. 6; Copeland, 1978, Pl. II, fig. 8.

Types. Hypotypes, GSC 72592, 72584, 72579, 72573.

Acanthoscapha subnavicula Abushik, 1968

Plate 18, figure 29

Acanthoscapha subnavicula Abushik, 1968, p. 75, Pl. VIII, figs. 6-9.

?*Acanthoscapha subnavicula* Abushik. Copeland, 1977, p. 40, Pl. IV, figs. 16-19; Copeland, 1978, Pl. II.2, figs. 11, 12.

Acanthoscapha subnavicula Abushik. Copeland, 1978, Pl. II, figs. 9, 11.

Acanthoscapha subnavicula Abushik. Stone and Berdan, 1984, p. 1002, figs. 9P-Q.

Type. Hypotype, GSC 72569.

Genus *Beecherella* Ulrich, 1891

Type species. Beecherella carinata Ulrich, 1891.

Beecherella roddicki n. sp.

Plate 4, figures 6, 7; Plate 5, figures 33, 34; Plate 16, figure 13

Description. Small beecherellid species with gentle preplete outline, angular, slightly obtuse flattened dorsal cardinal angles and long, straight hingeline. A flange extending along the entire venter, narrow, thread-like in presumed "male" specimens, broad and slightly flaring in presumed "female" specimens. Both types with flange terminating anteriorly and posteriorly near or slightly below mid height of valve in pronounced, apparently hollow, slightly laterally directed spines. Area between flange and marginal ridge narrow and channelled in "male" type specimens, broad and flat in "female" type specimens. Possible duplicature extending from flattened cardinal corners to anterior and posterior spine bases.

Dimensions (mm).	Length	Height
Paratype, GSC 72594	1.40	0.50
Holotype, GSC 72595	1.30	0.50
Paratype, GSC 72596	1.35	0.50
Paratype, GSC 72597	1.50	0.60

Types. Holotype, GSC 72595, paratypes, GSC 72594, 72596, 72597, 80827.

Remarks. This species most closely resembles *B. carinata* Ulrich, the type species from the Lower Devonian, lower Helderberg Group, Indian Ladder, New York (Berdan, 1960). Both have a ventral flange connecting the terminal spines, but the spines of *B. roddicki* are more pronounced. The possibly dimorphic differentiation of the flange (i.e. "male" - thread-like, "female" - broad and flaring) of *B. roddicki* n. sp. has not been noted previously in beecherellid species but there appears to be no reason that the figured and other observed specimens of both types are not conspecific. The duplicature of *B. carinata* as illustrated by Berdan (1960) is prominent, whereas the presumed duplicature of *B. roddicki* (which may represent only the internal expression of the flattened dorsolateral margins of the valve) is narrow and more restricted.

Beecherella rhomboidalis n. sp.

Plate 12, figures 20-28; Plate 17, figure 30

Description. Valve subrhomboidal in lateral view, hingeline slightly arched but subparallel with venter, anterodorsal and posteroventral margins extended, posterodorsal and anteroventral margins rounded. Posteroventral margin of valve drawn out into a minute spine from which rises a thin, thread-like crest that extends almost the entire length of the valve, increasing in distance above the venter as it proceeds anteriorly. Duplicature broad in anterior and posterior portions of the valve. Length of holotype, GSC 72613, 1.1 mm, height 0.4 mm.

Types. Holotype, GSC 72613, paratypes, GSC 80814-80818.

Remarks. This species lacks the typical beecherellid anterior process but possesses the posteroventral process and broad duplicature of *B. carinata* Ulrich. The ventral crest of *B. rhomboidalis* is progressively removed from the ventral margin of the valve, as it is followed anteriorly from the posteroventral spine, rather than remaining in a ventral position, as in most other beecherellids.

"*Beecherella*" sp.

Plate 17, figure 12

Description. Valve ovate in lateral view with relatively short hinge area and a posterior and anterior spine near mid height. Posterior spine the larger, more confluent with valve margin, anterior spine more peg-like and slightly removed from valve margin. Valve surface somewhat granular with a few scattered larger granules. Length of figured specimen, GSC 72587, 1.4 mm, height 0.6 mm.

Type. Figured specimen, GSC 72587.

Remarks. This species somewhat resembles "*Beecherella*" *cristata* Ulrich as figured by Berdan (1960) in lateral outline and type of terminal spines, but the posterior spine of "*Beecherella*" sp. is larger and the anterior spine is situated higher on the valve surface.

Genus *Shidelerites* Morris and Hill, 1951

Type species. Shidelerites typus Morris and Hill, 1951.

Shidelerites? laterospinosus n. sp.

Plate 5, figure 30; Figures 13a-e

Description. Preplete, hinge sunken slightly mid dorsally, about one-half of valve length; dorsum posteriorly curved to

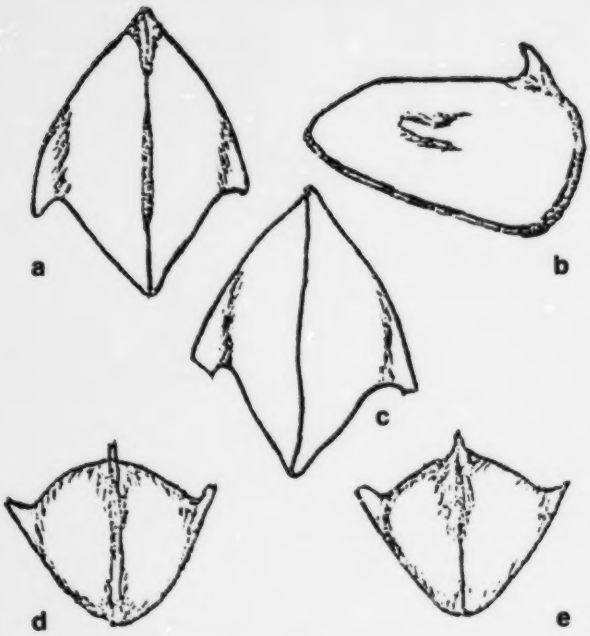


***Figure 13. Shidelerites? laterospinosus** n. sp. x27; a. dorsal, b. right lateral, c. ventral, d. anterior, e. posterior views of the holotype, GSC 72608.*

blunt posterior extremity, anteriorly drawn out into posteriorly curved anterior horn. Venter relatively straight, sloping anteriorly to meet broadly curved anterior margin. L/R overlap along ventral and possibly anterior margins, although the anterior margin appears to be laterally compressed, or to have a narrow flange on both valves. Surface smooth but with a pronounced posterodorsally directed alar-like process originating near mid valve. Length of holotype, a carapace, GSC 72608, 1.5 mm, height 1.0 mm.

Type. Holotype, GSC 72608.

Remarks. It is not certain whether this species should be assigned to *Shidelerites* within the Beecherellidae or to some obscure genus within the Tricorninidae. Certainly, *S.? laterospinosus* has an anterodorsal horn highly reminiscent of that of *Shidelerites typus* Morris and Hill (also see Berdan and Copeland, 1973, p. 32, Pl. 11, figs. 16, 17) but it also possesses a lateral alate projection in somewhat the same position as that of the lateral spines of several genera and species of the tricorninids (i.e. Stone and Berdan, 1984, Figure 10). The dorsal margin of most tricorninids is relatively straight and long, not ventrally inclined in its posterior part, and the hinge is not usually incised.

The present specimen does not possess the mid ventral invagination shown by *S. typus*, but the left valve shows greater overlap over the right valve in that position.

Shidelerites? laterospinosus differs from *S. yukonensis* Berdan and Copeland, 1973 in having a broadly curved anterior margin, like *S. typus*, and the curved anterodorsal horn in a more posterior position than the straight, dorsally directed, anterior horn of *S. yukonensis*.

Superfamily CYTHERACEA Baird, 1850

Family BEROUNELLIDAE Sohn and Berdan, 1960

Genus *Berounella* Bouček, 1936

Type species. Berounella rostrata Bouček, 1936.

Berounella spicata n. sp.

Plate 10, figure 25;
Plate 17, figure 35

Description. Hingeline long, extending along posterior dorsal prolongation of the valve. Anterior part of valve expanded, trilobate. L1 low, spinose anterodorsally, ventrally joined with L3 beneath L2. Preadductorial node globose, near mid valve, ventral of dorsal depression of joined preadductorial and adductorial sulci. Posterior lobe occupying posterior three-fifths of domicilium with an elongate spine posterior of the preadductorial node. Incurved portion of posteroventral margin of domicilium with a few low spines.

Dimensions (mm).	Length	Height
Holotype, GSC 72508	1.10	0.40
Paratype, GSC 72509	1.10	0.40

Types. Holotype, GSC 72508, paratype, GSC 72509.

Remarks. The extreme development of the spine (0.55 mm) on the posterior lobe of the domicilium distinguishes this species from *B. rostrata* Bouček, *B. spinosa* Blumenstengel, and *Berounella* species figured by Sohn and Berdan from the Kalkberg Formation of New York State.

Superfamily indeterminate

Family TRICORNINIDAE Blumenstengel, 1965

Genus *Tricornina* Bouček, 1936

Type species. Tricornina navicula Bouček, 1936.

Tricornina (Tricornina) navicula Bouček, 1936

Plate 5, figures 23, 25; Plate 17, figures 24, 25;
Plate 18, figures 21, 22

Tricornina navicula Bouček, 1936, p. 50, Pl. III, figs. 3a-c, 4

Tricornina (Tricornina) navicula Bouček. Grundel, 1966, p. 98.

Tricornina (Tricornina) navicula Bouček. Copeland, 1977, p. 42, Pl. III, fig. 15; Copeland, 1978, Pl. II, fig. 12.

Types. Hypotypes, GSC 72609, 72574-72578.

Genus *Ovornina* Grundel, 1966

Type species. Tricornina ovata Blumenstengel, 1962.

Subgenus *Tricornella* Grundel, 1966

Type species. Tricornina sagittaformis Blumenstengel, 1962.

Ovomina (Tricornella) perryi Copeland, 1977

Plate 5, figure 19; Plate 17, figure 29;
Plate 18, figures 1, 2, 20

Ovomina (Tricornella) perryi Copeland, 1977, p. 43, Pl. XI, figs. 1-3; Pl. XV, fig. 9.

Types. Hypotypes, GSC 72570-72572, 72591.

Ovomina? sp.

Plate 18, figure 26

The specimen was broken and cannot be described with any certainty.

Type. Figured specimen, GSC 72632.

Genus *Ockerella* Jordan, 1964

Type species. Ockerella tricornuta Jordan, 1964.

Ockerella jordani Copeland, 1977

Plate 5, figures 22, 24;
Plate 17, figures 22, 23, 26-28;
plate 18, figures 24, 25

Ockerella jordani Copeland, 1977, p. 43, Pl. IX, figs. 1-3; Pl. XV, fig. 9.

Ockerella jordani Copeland. Stone and Berdan, 1984, p. 1003.

Types. Hypotypes, GSC 72580-72583, 72588-72590, 72593, 72658.

Ockerella longula n. sp.

Plate 5, figure 26

Description. Valve almost three times as long as high, canoe-shaped. Hinge long, straight, cardinal angles protruding as short, dorsally directed spines. Lateral spine at venter, near mid length of valve; spine strong, curved in a posterolateral manner. Length of holotype, GSC 72610, 1.1 mm, height 0.4 mm (at mid valve).

Type. Holotype, GSC 72610.

Remarks. This species is much more elongate in relation to height than *O. jordani*, also, the cardinal spines are much shorter and weaker.

Suborder METACOPINA Sylvester-Bradley, 1961

Superfamily HEALDIACEA Harlton, 1933

Family KRAUSELLIDAE Berdan, 1961

Genus *Cooperatia* Tolmachoff, 1937

Cooperatia lacrimosa Copeland, 1977

Plate 4, figures 22, 23; Plate 16, figures 8-10;
Plate 18, figure 32

Cooperatia lacrimosa Copeland, 1977, p. 45, Pl. IV, figs. 22-24; Copeland, 1978, Table 11.1, Pl. 11.2, fig. 15.

Dimensions (mm).	Length	Height
Hypotype, GSC 72537	1.90	1.00
Hypotype, GSC 72539	1.20	0.60
Hypotype, GSC 72540	1.40	0.80

Types. Hypotypes, GSC 72537, 72539, 72540, 80824-80826.

Remarks. Variation appears to exist in the lateral outline of this species. Determination of the dorsal margin of carapaces is difficult; specimens may be oriented upside down, such as that in Plate 18, figure 32.

Genus *Antijanusella* Copeland, 1978

Type species. Antijanusella spinosa Copeland, 1978.

Antijanusella spinosa Copeland, 1978

Plate 17, figure 17;
Plate 18, figures 13, 14, 17

Antijanusella spinosa Copeland, 1978, p. 70, Pl. 11.2, figs. 8, 21, 22.

Dimensions (mm).	Length	Height (without dorsal spine)
Hypotype, GSC 72533	2.10	0.90
Hypotype, GSC 72534	2.00	0.90
Hypotype, GSC 72535	2.10	1.00
Hypotype, GSC 72656	2.10	1.00

Types. Hypotypes, GSC 72533-72535, 72656.

Remarks. Specimens in the present collections agree in all respects with those of the primary types, which were collected in the same general geographic area.

Antijanusella spicata n. sp.

Plate 4, figure 24;
Plate 5, figures 31, 32

Description. Antijanusellid species of general bairdiid lateral outline with highly arched dorsum drawn into a short, stout, dorsal spine on the right valve. All specimens studied are individual valves; assumed left valves are similar to right valves but lack a dorsal spine. Lateral surface of valve and dorsal spine granular.

Dimensions (mm).	Length	Height (without dorsal spine)
Holotype, GSC 72605	1.10	0.80
Paratype, GSC 72606	1.20	0.70
Paratype, GSC 72607	1.50	0.90

Types. Holotype, GSC 72605, paratypes, GSC 72606, 72607.

Remarks. This species is more highly arched and the dorsal spine and prolongation of the valves are shorter and more stout than in *A. spinosa*.

Genus *Janusella* Roth, 1929

Type species. Janusella biceratina Roth, 1929.

Janusella? *latispinosa* n. sp.

Plate 5, figures 27-29

Description. Preplete, valves ovate, more broadly rounded anteriorly. Cardinal areas rounded. Left valve larger than right valve, overlapping along free margins. Left valve with prominent, long spine near mid length of valve in ventral part, somewhat posteriorly directed. Surface smooth. Measurements of figured specimens (in mm) without dorsal process.

Dimensions (mm).	Length	Height
Holotype, GSC 72621	1.10	0.50
Paratype, GSC 72622	1.20	0.60
Paratype, GSC 72623	(broken)	0.70

Types. Holotype, GSC 72621, paratypes, 72622, 72623.

Remarks. This is the only species assigned, albeit questionably, to *Janusella* that possesses a lateral spine. This may preclude its inclusion in *Janusella* sensu stricto as exemplified by the type species of the genus, but little is known of the variability of species within the genus.

Genus *Baschkirina* Rozhdestvenskaya, 1959

Type species. Baschkirina memorabilis Rozhdestvenskaya, 1959.

Baschkirina? sp.

Plate 5, figure 17;
Plate 16, figure 2; Plate 17, figure 31;
Plate 18, figures 3, 27

Baschkirina? sp., Copeland, 1977, p. 45, Pl. III, figs. 20, 21; Pl. XI, fig. 7.

Types. Figured specimens, GSC 72611, 72612, 72614, 72615, 80889.

Remarks. It is still not certain if species of *Baschkirina* and *Krausella* are congeneric. The present species is widespread throughout the area of the Avalanche Lake sections and appears to have a broad stratigraphic range. Length of figured specimen, GSC 80889, 1.8 mm, height 1.0 mm.

Family CAVELLINIDAE Egorov, 1950

Genus *Voronina* Polenova, 1953

Type species. Voronina voronensis Polenova, 1952.

Voronina? sp.

Plate 4, figures 12-14

Types. Figured specimens, GSC 72685-72687.

Remarks. These specimens are only questionably referable to *Voronina*. They are posteriorly plenate and the dorsal margin is sloped anteriorly. The ventral margin is somewhat concave. The free margin shows a tendency to be thickened, especially in the anterior portion of the valve. Length of figured specimen, GSC 72628, 1.45 mm, height 0.9 mm.

Family BAIRDIOCYPRIDIDAE Shaver, 1961

Genus *Bairdiocypris* Kegel, 1932

Type species. Bythocypris (Bairdiocypris) gerolsteinensis Kegel, 1932.

Bairdiocypris longus Pranskevičius, 1972

Plate 14, figures 1, 2

Bairdiocypris longus Pranskevičius, 1972, p. 139, Pl. XXXIII, fig. 3.

Type. Hypotype, GSC 80835.

Remarks. Considerable variation is evident in specimens referred to this taxon. Some valves are slightly more acuminate posteriorly than others but the general L/H ratio remains relatively constant. The figured specimen demonstrates the hingement and ventral lappet more clearly than most other valves. Length of hypotype, GSC 80835, 1.4 mm, height 0.8 mm.

Bairdiocypris sp.

Plate 17, figure 3.

Type. Figured specimen, GSC 72643.

Genus *Cadmea* Pranskevičius, 1970

Type species. Cadmea inexplorata Pranskevičius, 1970.

Cadmea inexplorata Pranskevičius, 1970

Plate 16, figures 3-5

Cadmea inexplorata Pranskevičius, 1970, p. 152, Pl. XVI, figs. 1-3; Pranskevičius, 1972, p. 161, Pl. XXXIX, figs. 1-3.

Dimensions (mm).	Length	Height
Hypotype, GSC 80890	2.50	1.30
Hypotype, GSC 80891	2.20	1.00
Hypotype, GSC 80892	2.50	1.00

Types. Hypotypes, GSC 80890-80892.

Remarks. A certain amount of variation exists within specimens of this species as presently interpreted. This is shown by figures of the type specimens from Lithuania as well as those in the present collections. Some specimens are more highly arched (Pranskevičius, 1972, Pl. XXXIX, fig. 3a; herein Pl. 16, fig. 3) than others, resulting in a slight posterodorsal concavity in lateral view. As with the specimens figured by Pranskevičius (1972), there is a noticeable thickening of the anteriormost portion of the left valve. All of the present specimens are valves, precluding exact determination of valve overlap; however, examination of the closure margin would seem to indicate a L/R relationship for the free margin.

Cadmea acuta Copeland, 1977

Plate 17, figure 14

Cadmea acuta Copeland, 1977, p. 39, Pl. IV, fig. 6; Pl. XIII, figs. 6, 7, 9; Pl. XV, fig. 7.

Cadmea acuta Copeland. Copeland, 1978, Pl. 11.2, figs. 5-7.

Type. Hypotype, GSC 72650.

Genus *Longiscula* Netskaya, 1958

Type species. Longiscula arcuaris Netskaya, 1958.

Longiscula? sp.

Plate 18, figures 7, 8

Description. Valves about half as high as long. Dorsum slightly arched, left valve more elevated than right valve. Venter somewhat concave near mid valve. Surface smooth.

Dimensions (mm).	Length	Height
Figured specimen, GSC 72633	2.20	1.10
Figured specimen, GSC 72634	1.60	0.70

Types. Figured specimens, GSC 72633-72634.

Remarks. It is assumed that the disarticulated valves are parts of this taxon; no carapaces have been found. The general morphology is representative of *Longiscula*, but this is not certain.

Genus *Silenis* Neckaja, 1958

Type species. Silenis subtriangulatus subtriangulatus Neckaja, 1958.

Silenis mawii? (Jones)

Plate 6, figures 5, 6

Pontocypris mawii Jones, 1887, p. 182, Pl. 4, fig. 7.

Silenis mawii (Jones). Krandijevsky, 1963, p. 122, Pl. XII, figs. 1-3; Pranskevicius, 1972, p. 151, Pl. XXXV, figs. 1-3.

Arcuaria mawii (Jones). Neckaja, 1966, p. 58.

Silenis mawii (Jones). Gailite, Rybnikova and Ul'st, 1967, p. 160, Pl. XIII, fig. 8.

(The above is far from a complete synonymy, it only indicates some of the more recent generic assignments of the species.)

Discussion. This species is widespread throughout the Baltic region and also occurs in Great Britain. Its age is variously cited as middle Llandovery to early Wenlock. There appears to be great variation in shape within the species, particularly in height of the valves, but all specimens are pronouncedly elevated posterodorsally. Unfortunately, no carapaces have been observed in the present collections, so the overlap conditions of the valves are unknown.

Dimensions (mm).	Length	Height
Hypotype, GSC 72560	2.40	1.70
Hypotype, GSC 72561	2.30	1.50

Types. Hypotypes, GSC 72560, 72561.

Silenis proteus Pranskevicius, 1972

Plate 14, figures 3-5;
Plate 17, figures 1, 2

Silenis proteus Pranskevicius, 1972, p. 153, Pl. XXXII, figs. 1-3; Copeland, 1977, p. 44, Pl. XVI, figs. 13, 14; Copeland, 1978, p. 65.

Types. Hypotypes, GSC 72641, 72642, 80833, 80834.

Remarks. This species is less elevated posteriorly than *S. mawii*? (Jones) illustrated here in Plate 6, figures 5, 6. The hinge structure of the left valve consists of a straight ridge along the area of highest elevation that continues a short distance down the anterior slope of the valve.

Silenis symmetricus Pranskevicius, 1972

Plate 16, figure 1

Silenis symmetricus Pranskevicius, 1972, p. 154, Pl. XXXVII, fig. 1.

Type. Hypotype, GSC 80893.

Remarks. Specimens of this species are highest slightly anterior of mid length. Overlap by the left valve is pronounced except along the posterodorsal slope. The hinge is short, slightly incised and situated immediately behind the point of greatest height. Length of hypotype, GSC 80893, 1.9 mm, height 1.1 mm.

Genus *Arcuaria* Neckaja, 1958

Type species. Arcuaria sineclivula Neckaja, 1958.

Arcuaria delormensis Copeland, 1977

Plate 15, figures 13-15; Plate 17, figure 20;
Plate 18, figures 5, 6, 11.

Arcuaria delormensis Copeland, 1977, p. 44, Pl. IV, fig. 8.

Dimensions (mm).	Length	Height
Hypotype, GSC 72527	1.60	0.90
Hypotype, GSC 72528	1.50	1.00
Hypotype, GSC 72529	1.20	0.70
Hypotype, GSC 72530	1.20	0.70

Types. Hypotypes, GSC 72527-72530, 80819-80821.

Remarks. This species is closely related to *A. avalanchensis* Copeland, but lacks the extreme dorsal protuberance of the right valve that overreaches the hinge.

Arcuaria avalanchensis Copeland, 1978

Plate 4, figure 29; Plate 6, figure 11;
Plate 18, figures 10, 12

Arcuaria avalanchensis Copeland, 1978, p. 70, Pl. 11.2, figs. 1-4.

Dimensions (mm).	Length	Height
Hypotype, GSC 72531	1.75	0.80
Hypotype, GSC 72532	2.15	1.10
Hypotype, GSC 72530	1.95	1.10
Hypotype, GSC 72538	1.35	0.70

Types. Hypotypes, GSC 72530-72532, 72538.

Remarks. This species is generally older than *A. delormensis* but the ranges of both species appear to overlap.

Arcuaria sp. cf. *A. sineclivula* Neckaja, 1958

Plate 3, figure 24

Arcuaria sineclivula Neckaja, 1958, p. 368, Pl. 3, figs. 7-9.

Description. Valves subtriangular in lateral view, posterodorsal margin more steeply inclined than anterodorsal margin. Left valve overlapping right along most of the free margin, right valve slightly overhanging left dorsally. Valve surface slightly granular. Length of hypotype, GSC 72841, 1.9 mm, height 1.0 mm.

Type. Hypotype, GSC 72841.

Remarks. Specimens identified in the present study as this taxon appear to vary somewhat in shape, primarily in the position of the greatest height. Several studies of species of *Arcuaria, Silenis, Longiscula*, etc. have resulted in a proliferation of specific and subspecific nomenclature to the extent that positive identification at the specific level (except perhaps in the Baltic region) is difficult or impossible.

Genus *Microcheilinella* Geis, 1933

Type species. Microcheilus distorta Geis, 1932.

Microcheilinella spp.

Plate 14, figures 6, 7; Plate 17, figure 11

Description. Ovate, cardinal angles rounded, greatest length near mid height of valve, greatest height and width in posterior half. Hinge slightly sunken. Left valve slightly overreaches right dorsally and overlaps right valve ventrally. Surface smooth to slightly granular. Length of figured specimen (a carapace), GSC 80906, 1.1 mm, height 0.7 mm, width 0.8 mm.

Types. Figured specimens, GSC 80906, 80907, 72648.

Remarks. Most specimens are preserved as valves, which makes their identification uncertain. Undoubtedly several species are present in this large group. Pranskevičius (1972) recognized 19 microcheilinellid species in his study of Lower and Middle Silurian faunas of Lithuania; he demonstrated great variability in form especially in the width of carapaces. Some of his species may be present in the Avalanche Lake collections.

Genus *Medianella* Neckaja, 1966

Type species. Bythocypris aequa Stumber, 1956.

Medianella? sp.

Plate 6, figure 4

Description. Large, subovate valves, posteriorly more narrowly rounded than anteriorly. Dorsum slightly overreaching relatively short hinge. Valves with narrow, near marginal flange, surface smooth to granular. Length of figured specimen, GSC 72517, 3.2 mm, height 2.4 mm.

Type. Figured specimen, GSC 72517.

Remarks. This is a very large species of the genus. Only individual valves have been recovered so it is not possible to ascertain overlap relationships. The faint, near marginal ridge of the valves has not been previously noted.

Family PACHYDOMELLIDAE Berdan and Sohn, 1961

Genus *Tubulibairdia* Swartz, 1936

Type species. Tubulibairdia tubulifera Swartz, 1936.

Tubulibairdia sp.

Plate 4, figure 26;
Plate 15, figures 4-6; Plate 17, figures 5-7

Dimensions (mm).	Length	Height
Figured specimen, GSC 80900	0.80	0.45
Figured specimen, GSC 80901	1.00	0.50
Figured specimen, GSC 80902	0.65	0.40

Types. GSC figured specimens 80900-80902, 72659, 72645-72647.

Remarks. This species occurs commonly in the collections. Because enough specimens are found in which the tubules are visible on the interior of the valves, the assumption can be made that all valves and carapaces having this general lateral aspect belong in one generic taxon. Some steinkerns exhibit the tubules as short spinules.

Family unknown

Genus *Pseudorayella* Neckaja, 1960

Type species. Pseudorayella scala Neckaja, 1960.

Pseudorayella? sp.

Plate 12, figure 17

Discussion. Valve ovate with a prominent posterodorsal projection. As the only specimen found was broken subsequent to photography it is now not possible to determine if the projection was part of the hingeline or if it protruded dorsal of the hinge. Abushik (1971, p. 127, Pl. XLIV, figs. 7, 8) figured a specimen of *P. arta* (Abushik), 1968 that somewhat resembles the specimen shown here. The dorsal projection of *P. arta*, however, is more anterior in position than that of the present specimen.

Type. Figured specimen, GSC 80943.

Genus *Steusloffina* Teichert, 1937

Type species. Steusloffina ulrichi Teichert, 1937.

Steusloffina? symmetrica n. sp.

Plate 4, figures 20, 21; Plate 6, figure 7

Description. Valves nearly amplete, canoe-shaped in lateral view. Posterior cardinal angle somewhat more acute than anterior cardinal angle. Valves distinctly arched at mid dorsum, overhanging long, straight hinge. Left valve overlapping right valve along entire free margin, greatest overlap ventral. Surface of valve smooth, without lateral spinose projection. Length of holotype, GSC 72564, 1.5 mm, height 0.9 mm.

Types. Holotype, GSC 72564, paratypes, GSC 72691, 72692, unfigured paratypes, GSC 72565-72568.

Remarks. This species is more equilateral and symmetrical than the Ordovician species *S. ulrichi* Teichert and *S. cuneata* (Steusloff) and bears no indication of having had a lateral spine on each valve. Specimens of *Steusloffina* without lateral spines have been reported from Ordovician rocks elsewhere (Copeland, 1983) but this is the first reported occurrence from Silurian strata of North America.

Genus *Spinosteusloffina* n. gen.

Type species. Spinosteusloffina multispinosa n. sp.

Diagnosis. Podocopid ostracodes of steusloffinid lateral outline (somewhat triangular), pustulose domicilium, with prominent dorsal and lateral spines, one in the position of the near median lateral spine typical of *Steusloffina ulrichi* Teichert and *Steusloffina cuneata* (Steusloff). Both valves with broad ventral lappet, right valve with thin but prominent continuous stop ridge against which the overlapping left valve closes.

Discussion. Species of this genus may be compared generally with those of *Steusloffina* Teichert, 1937 mainly on the basis of lateral valve shape and presence of a near median valve spine. Most steusloffinids, however, are otherwise smooth, with the exception of *S. papillosa* Hessland, which is tuberculate on the anterior portion of the domicilium. The combination of dorsal spines, additional lateral spines and coarse pustules is considered sufficient evidence for a new genus to be proposed.

Spinosteusloffina multispinosa n. sp.

Plate 13, figures 12-15

Description. Triangular in lateral view, dorsum straight, anterior narrowly curved, posterior broadly curved, meeting dorsum at an acute, almost spine-like, angle. Surface, except for near marginal area, covered with spines, mostly pustule-like but with 2 prominent dorsal spines, one at the anterior dorsal cardinal angle and one near mid dorsum, and up to four, slightly less prominent lateral spines, one near mid valve, one anterodorsal of mid valve and two posterior of mid valve. The four lateral spines and cardinal spines tend to form a broad curve.

Left valve broadly overlapping right, both valves with prominent ventral lappet bordered on the right valve with a prominent stop ridge against which the left valve closes, and on the left valve by a less distinct, rounded ridge which is separated from the lateral surface of the valve by a low groove.

Dimensions (mm).	Length	Height
Paratype, GSC 80923	0.70	0.40
Holotype, GSC 80924	0.70	0.50
Paratype, GSC 80925	0.75	0.50
Paratype, GSC 80926	0.75	0.50

Types. Holotype, GSC 80924, paratypes, GSC 80923, 80925, 80926.

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APPENDIX A

OCCURRENCE OF UPPER ORDOVICIAN (RICHMOND-GAMACHE) AND LOWER SILURIAN (ANTICOSTI) OSTRACODE GENERA, ANTICOSTI ISLAND, QUEBEC
(Copeland, 1970a, b, 1973, 1974b, 1981, 1982a, 1983)

GENERA	RICHMONDIAN	GAMACHIAN	ANTICOSTIAN			
	VAURÉAL FM.	ELLIS BAY FM.	BECSCIE FM.	GUN RIVER FM.	JUPITER FM.	CHICOTTE FM.
Aechmina	•	•	•		•	
"Aparchites"	•					
Ceratopsis	•					
Cytherellina	•					
Eographiodactylus	•	•				
Eokloedenella	•	•				
Eoleperditia	•					
Jonesites	•	•				
Krausella?	•	•				
Laccoprimitia	•				?	
Leperditella?	•	•	•	•	•	
Macrocyproides	•	•				
Milleratia	•	•				
Monoceratella	•	•				
Monotiopleura	•					
Paraschmidtella	•	•				
Phelobythocypris	•	•	•	•	•	
Platyrhomboides?	•	•				
Primitiella	•	•				
Schmidtella	•	•				
Tetradella	•	•				
Tubulibairdia?	•	•			•	
Warthinia	•					
Anticostiella		•	•	•	•	
Bolbiprimitia?		•				
Carinobolbina		•				
Chilobolbina?		•				
Cryptophyllus		•	•	•	•	
Ctenoboldina		•				
Daleiella?		•				•
Eoaquapulex		•				
Euprimitia		•				
Faurella		•				
Foramenella		•				
Neoschmidtella		•				
Platybolbina		•				
Pseudulrichia		•				
Steusloffina		•				
Anticostibolbina			•			
Bairdiacypris			•	•		
Bolbineossia (Bolbineossia)			•			
B. (Brevibolbineossia)			•	•	•	•
Bollia			•			
Clintiella			•			
Conbathella			•	•	•	•
Eukloedenella			•			
Herrmannina			•	•	•	
Kiltsiella			•			
Kirkbyella (Berdanella)			•			
Libumella			•		•	•
Loutriella			•			
Microchelinella			•	•	•	
Paraschmidtella			•	•	•	
Zygobursa			•			
Baschkirina				•		•
Bolbibollia				•	•	•
Pachydomella				•	•	
Apatobolbina					•	•
Bairdiocypris?					•	•
Cyrtocyprus					•	
Cytherellina?					•	
Eustephanella?					•	•
Jupiterella					•	
Menoeidina					•	
Noviportia					•	•
Paraechmina					•	
Punctomosea					•	•
Silenis					•	•
Thlipsura?					•	
Thrallella					•	•
Zygobolba					•	•
Beyrichia (Beyrichia)					•	•
Craspedobolbina (Artiocraspedon)						•
Neoprimitiella						•
Roundyella?						•

APPENDIX B

OCCURRENCE OF UPPER ORDOVICIAN OSTRACODE GENERA, NORTHERN EUROPE

GENERA	LITHUANIA (Pranskevicius, 1972)	LATVIA (Ul'st, Gailete, Yakovliva, 1982)	ESTONIA (Sarv, 1959)	NORWAY (Siveter, 1982)			GREAT BRITAIN (Siveter, 1978a)
	U. ORDOVICIAN	F_{Ic}	F_{II}	F_{Ic}	5a	5b	U. ORDOVICIAN
Bairdiocypris	•						
Leperditella	•	•		•			
Medianella	•	•					
Microcheilinella	•	•					
Olbia	•						
Platybolbina	•	•		•	•	•	
Pseudorayella	•						
Rectella	•	•	•				
Steusloffina	•	•				•	
Tvaerenella	•	•		•			
Airina		•				•	
Amplectochilina		•					
Arcuaria		•					
Breviobolbina		•	•	•			
Bubnoffiopsis		•					
Cryptophyllus		•					
Distobolbina		•					
Foramenella		•		•			
Grammolomatella		•					
Kinnekullia		•					
Klimphores		•					
Laccoprimitia		•					
Neoprimitiella		•					
Oecematobolbina		•					
Parabolbina		•					
Paraphores		•					
Parapyxion		•					
Pedomphalella		•					
Piretella		•		•			
Sigmobolbina		•	•				
Tetradella		•		•	•	•	•
Uhakiella		•		•	•	•	•
Ulrichia		•	•	•			•
Warthinia		•					
Aechmina			•				
Ancora			•				
Bollia			•			•	
Drepanella?			•				
Jonesina?			•				
Pseudulrichia			•				
Bolbina?				•			
Oepikella				•			
Pseudotallinnella				•			
Cystomatochilina					•		
Eoaquapulex					•	•	
Kiesowia					•	•	
Oepikium					•	•	
Ceratopsis							•
Harperopsis							•
Sigmoopsis							•

APPENDIX C

OCCURRENCES OF UPPER ORDOVICIAN, LOWER AND MIDDLE SILURIAN OSTRACODE GENERA, PODOLIA (Abushik, 1968, 1971, 1983)

GENERA	UPPER ORDOVICIAN	LOWER-MIDDLE SILURIAN				
		LLANDOVERY	WENLOCK			LUDLOW
		lower	middle	upper	lower	
Arcuaria	•					
Bolbina	•					
Platybolbina	•					
Steusloffina	•					
Tetradella	•					
Altha		•	•	•		
Apatobolbina		•	•			
Bollia		•				
Longiscella		•	•			
Microcheilinella		•	•	•	•	•
Neckajatia		•	•	•		
Neoprimitiella		•	•			
Pseudoaparchites		•	•	•	•	•
Pseudorayella		•			•	•
Rectalloides		•			•	
Rishona		•	•	•		•
Silenis		•	•	•	•	•
Thlipsuroides		•	•			
Bairdiocypris			•	•		
Thlipsura			•	•	•	•
Birdsallella				•	•	•
Clavofabella				•	•	•
Craspedobolbina (Mitrobeyrichia)				•	•	•
Craspedobolbina (Odoniobolbina)				•		
Gothlandella				•	•	•
Herrmannina				•	•	•
Leptobolbina				•		•
Bairdiacypris					•	•
Beyrichia (Beyrichia)					•	•
Garniella					•	•
Ochesaarina					•	•
Pribylites					•	•
Alveolella					•	•
Amygdalella						•
Baschkirina						•
Berolinella						•
Beyrichia (Asperibeyrichia)						•
Calcaribeyrichia						•
Cytherellina						•
Euklocedenella						•
Hammariella						•
Hemsiella						•
Leperditia						•
Longiscula						•
Neobeyrichia						•
Opisthoplax						•
Plicybeyrichia						•
Retisacculus						•
Semilimbinariella						•
Signetopsis						•
Simplicibeyrichia						•

APPENDIX D

OCCURRENCE OF LOWER AND LOWER MIDDLE SILURIAN OSTRACODE GENERA, (GENERALIZED) OSLO REGION, NORWAY (Siveter, 1982)

GENERA	LLANDOVERY						WENLOCK		
	6a	6b	6c	7a	7b	7c	8a	8b	8c
Leperditia spp.	•	•	•	•	•	•	•	•	•
Eobeyrichia		•	•	•	•	•			
Primitiella?		•	•						
Splendia		•	•	•	•				
Craspedobolbina				•	•				
Apatobolbina							•	•	•
Beyrichia (*Altibeyrichia*)							•	•	•
Beyrichia (*Beyrichia*)							•	•	•

APPENDIX E

OCCURRENCE OF LOWER AND MIDDLE SILURIAN BEYRICHIACEAN OSTRACODE GENERA, GOTLAND, SWEDEN (Martinsson, 1962)

GENERA	LLANDOVERY	WENLOCK			LUDLOW	
	upper	lower	middle	upper	lower	middle
Apatobolbina	•	•				
Barymetopon	•					
Beyrichia (*Beyrichia*)	•	•	•	•	•	
Beyrichia (*Scabribeyrichia*)	•		•			
Craspedobolbina	•	•	•	•	•	
Leptobolbina	•		•			
Noviportia	•					
Beyrichia (*Asperibeyrichia*)		•	•		•	
Bingeria		•				
Clintiella		•	•	•	•	
Aitilia			•	•	•	
Beyrichia (*Altibeyrichia*)			•	•		
Beyrichia (*Lunulibeyrichia*)			•			
Bolbiprimitia			•	•		
Garniella			•		•	
Hyrsinobolbina			•			
Kolmodinia			•	•		
Amphitoxotis					•	
Atterdagia					•	
Beyrichia (*Simplicibeyrichia*)					•	•
Calcaribeyrichia					•	•
Gannibeyrichia					•	
Grogarnia					•	
Hammariella					•	
Hamulinavis					•	
Hemsiella					•	•
Hexamphthalmoides					•	
Hoburgiella					•	•
Laurella					•	
Lophoctenella					•	•
Navibeyrichia					•	•
Neobeyrichia					•	•
Plicibeyrichia					•	•
Retisacculus					•	•
Sieia					•	•
Vinculoveliger					•	
Cryptolopholobus						•
Juviella						•

APPENDIX F

OCCURRENCE OF UPPER LANDOVERY - LOWER WENLOCK OSTRACODE GENERA, VATTENFALLET SECTION, VISBY, GOTLAND, SWEDEN (Andersson, 1979; Sethia, 1979; Lundin, 1979)

GENERA	UPPER LLANDOVERY		LOWER WENLOCK			
	Lower[1] Visby marl	Upper Visby marl	Hoglint list a	b	c	d
Apatobolbina	•				•	
Berymetopon	•	•	•	•	•	
Berynchia (Beynchia)	•	•	•	•	•	•
Bollia	•	•	•	•	•	•
Craspedobolbina	•	•	•	•	•	•
Leptobolbina	•					
Neoprimitiella	•	•	•	•	•	
Noviportia	•					
Pseudoaparchites	•	•	•	•	•	•
Pseudorayella	•	•	•		•	•
Thlipsura	•	•	•	•		
Aechmina		•		•	•	
"Bythocypris"		•	•	•	•	
Clavofabella		•		•	•	
Cryptophyllus		•	•	•	•	•
Daleiella		•	•	•	•	
Diceratobolbina		•		•	•	•
Healdianella		•	•	•		
Longicella		•	•	•	•	•
Longiuscula		•	•	•	•	•
Nyhammella		•	•	•	•	
Parahippa		•				•
Paraprimitia?		•		•	•	
Scaphina		•		•	•	
Silenis		•	•	•	•	•
Steusloffina		•				
Ulrichia?		•		•	•	•
Venzavella		•	•	•	•	
Altha			•	•		
Birdsallella			•	•		
Medianella			•	•	•	
Monoceratella				•		
Retisacculus				•		
Silenis				•		
Gotlandella				•	•	
Opisthoplax				•	•	
Aechminana				•	•	•
Attilia				•	•	•
Bingena				•	•	•
Clintiella				•	•	•
Vattenfallia				•	•	•
Eoleperditia					•	
Garniella					•	
Murtiella					•	
Platybolbina					•	
Signetopsis					•	
Cadmiea					•	•
Herrmannina					•	•
Jagatiella					•	•
Microchilina						•

[1] *Apatobolbina, Leptobolbina, Noviportia, Beynchia (Beynchia)* and *Craspedobolbina (Mitrobeynchia)* reported by Martinsson (1967) from the subsurface of Gotland. *Beynchia (Beynchia)* occurs to within 13.8 m of the Ordovician-Silurian contact. The age of these faunas within the Llandovery is not presently known. For additional discussion see Thorslund (1968) and Martinsson (1967).

APPENDIX G

BEYRICHIACEAN ZONATION OF GOTLAND, SWEDEN
(Martinsson, 1967)

LLANDOVERY	WENLOCK			LUDLOW
upper	lower	middle	upper	lower
Apatobolbina simplicidorsata *Leptobolbina hypnodes* *Noviportia simpliciuscula* *C. (Mitobeyrichia) unculifera*	*Apatobolbina tricuspidata* *Apatobolbina gutnica* *C. (Craspedobolbina) ornulata* *B. (Asperibeyrichia) hystricoides*	*Bingeria* spp. *C. (C.) mucronulata* *B. (B.) erinacea* *C. (M.) sinnarvensis* *Leptobolbina quadricuspidata* *C. (M.) cuspidulata*	*C. (M.) variolata* *C. (M.) lunata* *B. (B.) peponulifera* *Prisculella garnieloides* *Calcaribeyrichia duplicicalcarata*	*Amphitoxotis curvata* *C. (M.) robusta* *B. (Asperibeyrichia) haidbyensis* *Hammariella pulchrivelata* *Neobeyrichia nutans*

APPENDIX H

OCCURRENCE OF LOWER AND MIDDLE SILURIAN OSTRACODE GENERA, LITHUANIA
(Pranskevičius, 1972, 1975)

GENERA	LLANDOVERY		WENLOCK	LUDLOW
	lower	upper		lower
Arcuaria	•	•		•
Bairdiocypris	•		•	
Macrocypris	•			•
Medianella	•			
Microcheilinella	•	•	•	
Olbia	•			•
Pseudorayella	•	•		
Rectella	•		•	
Altha		•	•	•
Longiscula		•	•	•
Pseudoaparchites		•	•	•
Pseudobollia		•	•	•
Rishona		•		
Silenis		•	•	•
Birdsallella			•	•
Cadmea			•	
Healdianella			•	•
Longicella			•	
Rectalloides			•	•
Thlipsohealdia			•	•
Bairdiacypris				•
Beyrichia (Beyrichia)				•
Beyrichia (Simplicibeyrichia)				•
Calcaribeyrichia				•
Craspedobolbina				•
Gannibeyrichia				•
Hammariella				•
Hemsiella				•
Hoburgiella				•
Juviella				•
Leiocyamus				•
Lophoctenella				•
Navibeyrichia				•
Neobeyrichia				•
Ochesaarina				•
Ortygia				•
Plicibeyrichia				•
Retisacculus				•

APPENDIX I

OCCURRENCE OF LOWER AND MIDDLE SILURIAN OSTRACODE GENERA, GREAT BRITAIN
(Siveter, 1978b, 1980[1])

GENERA	LLANDOVERY			WENLOCK		LUDLOW
	lower	middle	upper	lower	upper	lower
Beyrichia			•		•	•
Craspedobolbina (Articocraspedon)		?	•			
Craspedobolbina (Mitrobeyrichia)		?	•	•		
Craspedobolbina (Craspedobolbina)			•			
Craspedobolbina? sp. nov. B			•			
Jonesites			•			
Parabolbina			•		•	•
Stroterobolbina			•			
Amphitoxotidinae gen. nov. A				•		
Bollia				•		
Dictyotoxotis				•		
Nudista				•		
Parasleia				•		
Parulrichia				•		
Thlipsura				•		
Undipila				•		
Aechmina					•	
Aetholicotoxotis					•	•
Amphitoxotis					•	
Amphitoxotidinae gen. nov. B					•	•
"Beyrichia"					•	
Charitoxotis					•	
Equicastanea					•	
Garniella					•	
Gen. nov. F					•	
Gen. nov. J					•	•
Gongylostonyx					•	
Octonaria					•	
Oamotoxotis					•	•
Primitopsis					•	
Sarmatotoxotis					•	•
Sleia					•	•
Strepula					•	•
Tinotoxotis					•	?
Tribotoxotis					•	•
Tropidotoxotis					•	
Zorotoxotis					•	•

[1]At the time this list was compiled, part II of Siveter (1980) was unpublished.

APPENDIX J

OSTRACODE DISTRIBUTION ACROSS THE BASE OF THE WENLOCK SERIES IN THE TYPE AREA[1]
(Mabillard and Aldridge, 1985)

GENERA	LLANDOVERY					WENLOCK		
	TELYCHIAN STAGE					SHEINWOODIAN STAGE		
	purple shales					BUILDWAS FORMATION		
	B[2]	C	D	E	F	G		
Bairdiocypris? phillipsiana	•		•		•	•	•	
*Baschkirina? spinosa**	•		•					
Bythocypris? grandis	•		•		•	•	•	
Bythocypris? phaseola	•		•		•	•		
Craspedobolbina hipposiderus	•							
*Libumella marginata**	•		•		•	•	•	•
*Menoeidina lavoei**	•		•		•			
Rectella sp. aff. *R. galba*	•		•		•	•		
Rectella spp.	•		•		•	•	•	
Thlipsura? sp.	•							
Tubulibairdia sp.	•		•		•	•	•	•
Aechmina spp.			•		•			
Altha subquadrata			•		•	•	•	•
Craspedobolbina interrupta			•		•	•	•	•
Gen. et sp. indet.			•		•			
Hemiaechminoides monospinosus			•		•			
Macrocypris? vinei					•	•		
Tubulibairdia alabamensis						•		
Beyrichia admixta								•
Bollia bicollina								•
Leperditia copelandi								•
Leperditia sp.								•
Parulrichia diversa								•
Ulrichia sp.								•

[1]About 100 cm of Llandovery and 100 cm of Wenlock strata are represented in this diagram.
[2]Levels B to G indicate units of Bassett et al. (1975). * indicates the presence of this species in the Jupiter/Chicotte formations of Anticosti Island, Quebec. Limestone units C and E contain similar ostracode assemblages to those in adjacent units B, D, and F, but were not examined in detail.
(After Mabillard and Aldridge, 1985, Textfigure 8.)

PLATES 1-18

PLATE 1

Ordovician, Whittaker Formation

Figures 1-3. *Platybolbina* (*Reticulobolbina*) *lenzi* Copeland

1. Left valve, tecnomorph, x28.5, locality AV1-95.5 m, hypotype, GSC 72763.

2. Left valve, heteromorph, x28, locality AV1-95.5 m, hypotype, GSC 72764.

3. Right valve, tecnomorph, x28.5, locality AV1-86 m, hypotype, GSC 72765.

Figures 4, 5, 24. *Krausella* spp.

4. Right valve, x30.8, locality AV1-54 m, figured specimen, GSC 72766.

5. Right valve, x29, locality AV1-54 m, figured specimen, GSC 72767.

24. Carapace, left lateral view, x28, locality AV1-95.5 m, figured specimen, GSC 72768.

Figures 6, 7. *Leperditella* sp. cf. *L. globosa* Sarv

6. Left valve, x31, locality AV1-95.5 m, hypotype, GSC 72769.

7. Right valve, x31, locality AV1-53.5 m, hypotype, GSC 72770.

Figures 8, 9. *Aechmina* spp.

8. Right valve, x67, locality AV1-92 m, figured specimen, GSC 72771.

9. Right valve, oblique view, x70, locality AV1-95.5 m, figured specimen, GSC 72772.

Figures 10, 11, 14, 15. *Aechmina wolfensis* Copeland

10. Right valve, ventral view, x70, locality AV1-92 m, hypotype, GSC 72773.

11. Right valve, dorsal view, x65, locality AV1-92 m, hypotype, GSC 72774.

14. Right valve, x59, locality AV1-95.5 m, hypotype, GSC 72775 (= Plate 4, figure 31).

15. Left valve, x67, locality AV1-92 m, hypotype, GSC 72776.

Figures 12, 17-23, 25-28. *Lambeodella uniloculata* n. sp. (tecnomorphs)

12. Left valve, x50, locality AV1-53.5 m, paratype, GSC 72777.

17. Left valve, interior view, x29, locality AV1-53.5 m, paratype, GSC 72780.

18. Left valve, ventral view, x33, locality AV1-54 m, paratype, GSC 72781.

19. Right valve, x24, locality AV1-53.5 m, paratype, GSC 72782.

20. Left valve, x24, locality AV1-53.5 m, paratype, GSC 72783.

21. Left valve, x26, locality AV1-53.5 m, paratype, GSC 72784.

22. Right valve, x30, locality AV1-53.5 m, paratype, GSC 72785.

23. Left valve, interior view, x23, locality AV1-53.5 m, paratype, GSC 72786.

25. Left valve, x29, locality AV1-53.5 m, paratype, GSC 72787.

26. Right valve, ventral view, x33, locality AV1-54 m, paratype, GSC 72788.

27. Left valve, ventral view, x27, locality AV1-54 m, paratype, GSC 72789.

28. Left valve, x25.5, locality AV1-54 m, paratype, GSC 72790.

Figure 13. *Anticostiella reticulata* n. sp.

Left valve, interior view, x67, locality AV1-54 m, paratype, GSC 72778.

Figure 16. *Cystomatochilina* sp.

Left valve, x34, locality AV1-53.5 m, figured specimen, GSC 72779.

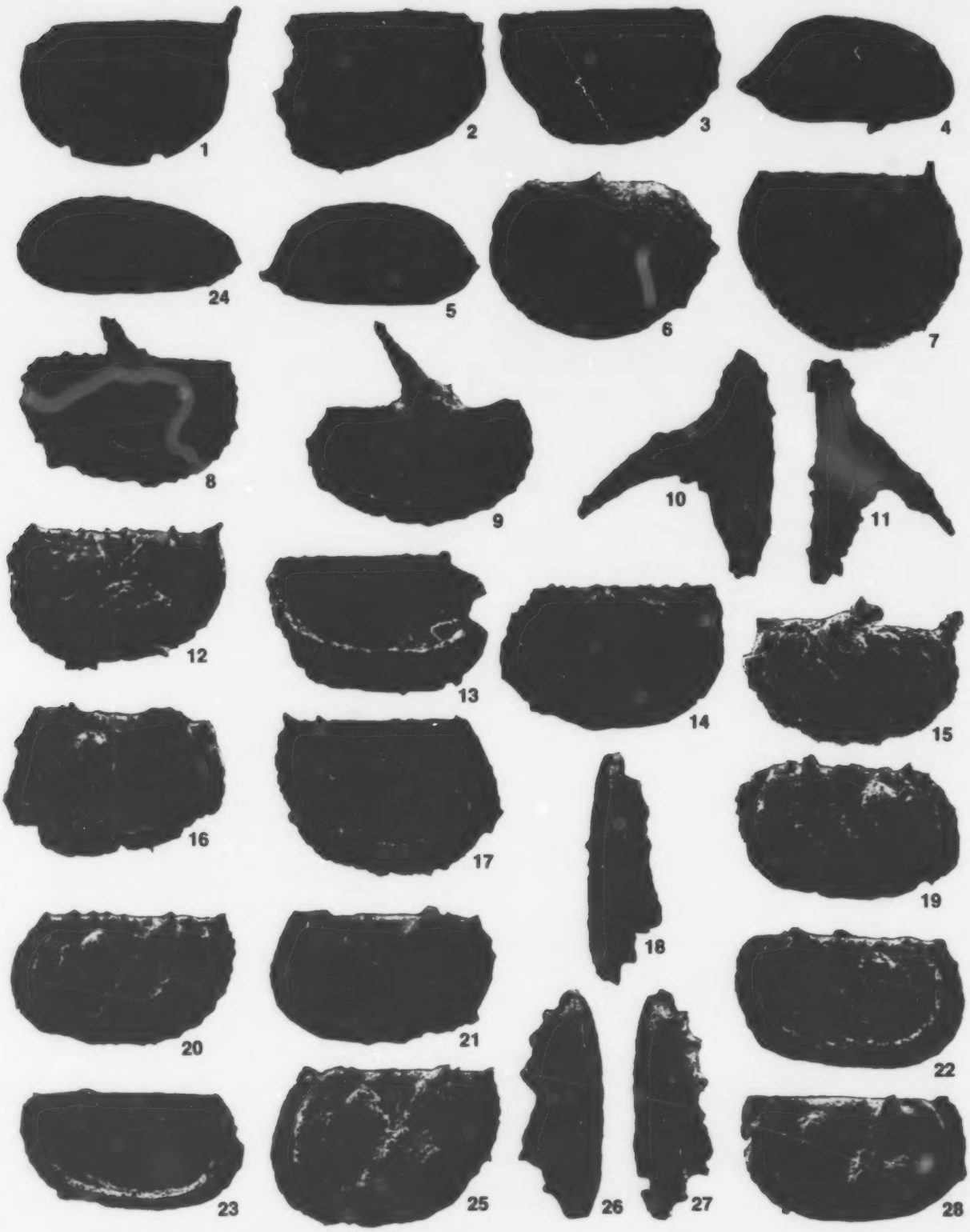
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PLATE 2

Ordovician, Whittaker Formation
(All specimens from locality AVI-53.5 m)

Figures 1-5. *Lambeodella unilocularata* n. sp. (heteromorphs)

1-3. Right valve, anterior view, x100, x38, x38 (45°), holotype, GSC 72791 (a-antrum, h-histium, l-loculus, m-margin, v-velum).

4. Left valve, ventral view, x27, paratype, GSC 72792 (lettering as for figure 3).

5. Right valve, x30, paratype, GSC 72793.

Figures 6-8. *Bromidella obesa* n. sp.

6. Left valve, tecnomorph, x82, paratype, GSC 72794.

7. Left valve, tecnomorph, x75, paratype, GSC 72795.

8. Left valve, heteromorph, x59, holotype, GSC 72796.

Figure 9. *Schmidtella*? sp.

Left? valve, x64, figured specimen, GSC 72797.

Figures 10-12. *Oepikella* sp.

10. Right valve, tecnomorph, x20, figured specimen, GSC 72798.

11. Left valve, heteromorph, x17, figured specimen, GSC 72799.

12. Left valve, immature specimen, x41, figured specimen, GSC 72800.

Figures 13, 27, 28. *Aechmina* spp.

13. Left valve, x82, figured specimen, GSC 72801.

27. Left valve, x75, figured specimen, GSC 72802.

28. Left valve, x51, figured specimen, GSC 72803.

Figure 14. *Primitia*? sp.

Left valve, x75, figured specimen, GSC 72804.

Figures 15-17. *Homeokiesowia* sp.

15. Left valve, x104, figured specimen, GSC 72805.

16. Right valve, x102, figured specimen, GSC 72806.

17. Left valve, x128, figured specimen, GSC 72807.

Figure 18. *Phelobythocypris cylindrica* (Hall)

Left valve, x38, hypotype, GSC 72808.

Figures 19-25. *Anticostiella reticulata* n. sp.

19-21. Right valves, tecnomorphs, x82, x64, x57, paratypes, GSC 72809-72811.

22. Left valve, tecnomorph, x84, paratype, GSC 72812.

23. Right valve, tecnomorph, x46, paratype, GSC 72813.

24. Left valve, heteromorph, x77, holotype, GSC 72814.

25. Left valve, ventral view, heteromorph, x58, paratype, GSC 72815.

Figure 26. *Cystomatochilina* sp.

Right valve, x47, figured specimen, GSC 72816.

Figures 29, 30. *Aechmina overi* n. sp.

29, 30. Right valve, anteroventral spinose frill approximately x200, valve x72, holotype, GSC 72817.

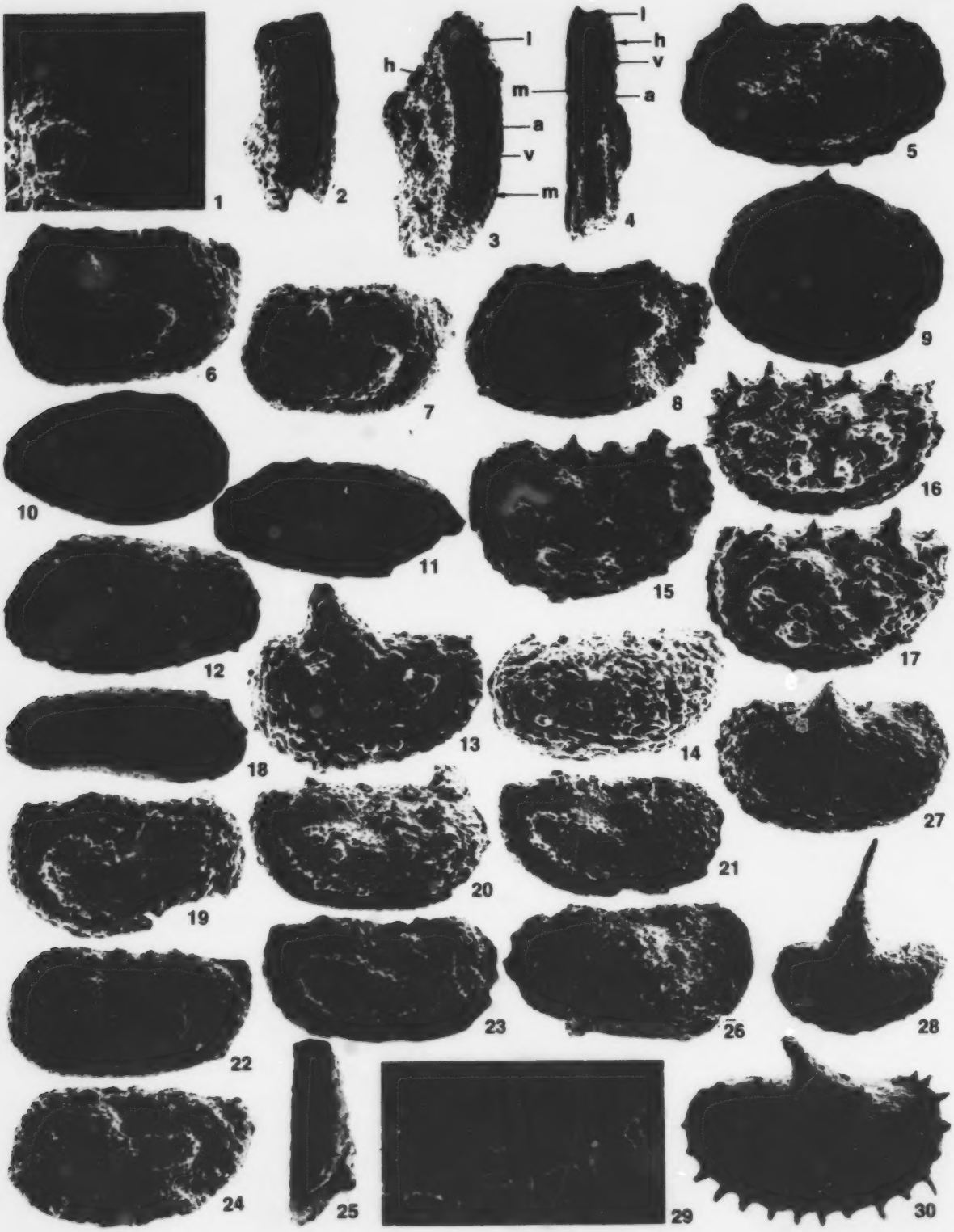
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PLATE 3

Ordovician, Whittaker Formation

Figures 1, 2. *Krausella* spp.

1, 2. Right valves, x39 and x42, locality AV1-53.3 m, figured specimens, GSC 72818, 72819.

Figure 3. *Parulrichia*? sp.

Right valve, x153, locality AV4B-111 m, figured specimen, GSC 72820.

Figures 4-6. *Eurychilina*? sp. indet. 1

4. Right valve, x58, locality AV1-54 m, figured specimen, GSC 72821.

5. Left valve, x59, locality AV1-54 m, figured specimen, GSC 72822.

6. Left valve, x58, locality AV1-54 m, figured specimen, GSC 72823.

Figure 7. *Phelobythocypris* sp.

Right? valve, x47, locality AV1-53.5 m, figured specimen, GSC 72824.

Figures 8, 9. *Aechmina* spp.

8, 9. Left valves, x58 and x64, locality AV1-95.6 m, figured specimens, GSC 72825, 72826.

Figures 10-14. *Steusloffina* sp. cf. *S. cuneata* (Steusloff)

10. Left valve, x51, locality AV1-95.5 m, hypotype, GSC 72827.

11. Left valve, interior view, x41, locality AV1-95.5 m, hypotype, GSC 72828.

12. Carapace, dorsal view, x31, locality AV4B-111.5 m, hypotype, GSC 72729.

13. Right valve, x49, locality AV4B-111.5 m, hypotype, GSC 72830.

14. Carapace, right lateral view, x35, locality AV4B-111.5 m, hypotype, GSC 72831.

Figure 15. *Leperditella* sp. cf. *L. globosa* Sarv

Carapace, right lateral view, x66, locality AV1-54 m, hypotype, GSC 72832.

Figure 16. *Bollia* sp.

Carapace, left lateral view, xlll, locality AV4B-112 m, figured specimen, GSC 72833.

Figures 17-19. *Pheloparasclerites berdanae* n. sp.

17. Carapace, right lateral view, x24, locality AV4B-111.5 m, paratype, GSC 72834.

18. Right valve, interior view, x25, locality AV4B-111.5 m, holotype, GSC 72835.

19. Left valve, interior view, x23, locality AV4B-111.5 m, paratype, GSC 72836.

Silurian, Whittaker Formation
(All specimens from locality AV1-124.5 m)

Figure 20. *Primitiella* sp. 2

Left valve, x18.5, figured specimen, GSC 72837.

Figure 21. *Undulirete*? sp.

Left valve, x31, figured specimen, GSC 72838.

Figure 22. *Eurybolbina* sp.

Right valve, x21, figured specimen, GSC 72839.

Figure 23. *Saccarchites*? sp.

Lateral view of a valve, x12.5, figured specimen, GSC 72840.

Figure 24. *Arcuaria* sp. cf. *A. sineclivula* Neckaja, 1958

Carapace, right lateral view, x19, hypotype, GSC 72841.

Figures 25, 28. *Leptobolbina*? sp. 2

25. Right valve, x34, figured specimen, GSC 72842.

28. Left valve, x36, figured specimen, GSC 72845.

Figure 26. *Pribylites*? sp.

Left valve, x35, figured specimen, GSC 72843.

Figures 27, 31. *Libumella* sp. indet.

27. Lateral view, x32, figured specimen, GSC 72844.

31. Lateral view, specimen lost.

Figures 29, 30. *Craspedobolbina*? sp.

29. Left valve, heteromorph, x36, figured specimen, GSC 72846.

30. Right valve, x35, figured specimen, GSC 72847.

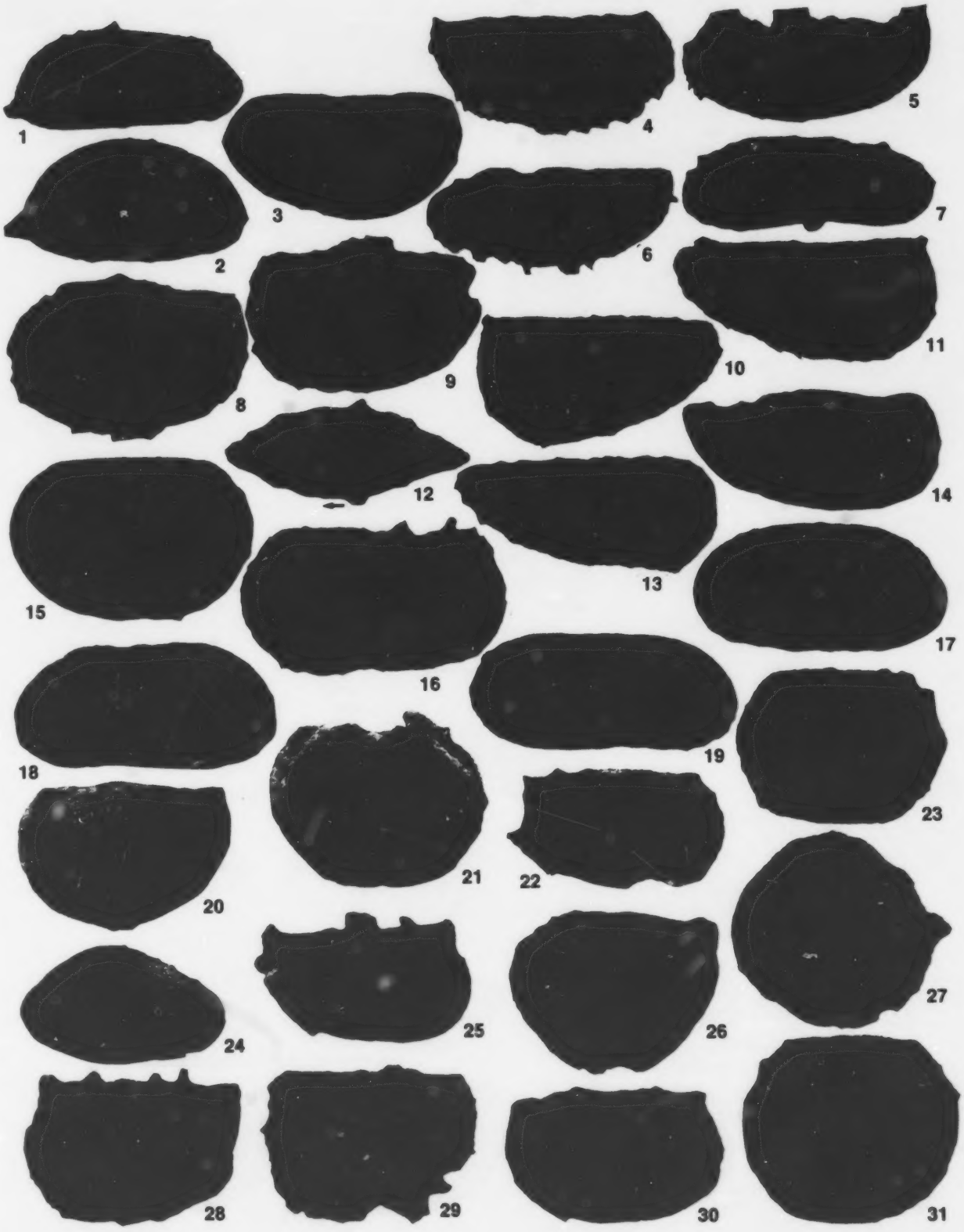
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PLATE 4

Silurian, Whittaker Formation

Figure 1. *Bingeria*? sp.

Right(?) valve, interior view, x22, locality AV3-5 m, figured specimen, GSC 72695.

Figure 2. *Hyrsinobolbina* sp.

Right valve, x31, locality AV3-5 m, figured specimen, GSC 72694.

Figures 3, 5. *Libumella* sp. indet.

3. Right(?) valve, x26, locality AV2-152 m, figured specimen, GSC 72516.

5. Left(?) valve, x26, locality AV2-152 m, figured specimen, GSC 72515.

Figure 4. Beyrichiacean indet. 4

Left valve, heteromorph, x24, locality AV2-11.5 m, figured specimen, GSC 72696.

Figures 6, 7. *Beecherella roddicki* n. sp.

6. Left valve, interior view, x30, locality AV3-5 m, paratype, GSC 72596.

7. Right valve, x30, locality AV3-5 m, paratype, GSC 72597.

Figure 8. *Apatobolbina*? sp.

Right valve, heteromorph, approximately x30, locality AV1-341 m, figured specimen, GSC 72697.

Figures 9, 19, 33. *Saccarchites*? sp.

9. Carapace, right lateral view, x27, locality AV2-11.5 m, figured specimen, GSC 72699.

19. Left valve, heteromorph, x37, locality AV2-11.5.m, figured specimen, GSC 72541.

33. Left valve, heteromorph, x20.5, locality AV1-124.5 m, figured specimen, GSC 72542.

Figure 10. Palaeocopid indet. 2

Left valve, x30, locality AV3-5 m, figured specimen, GSC 72698.

Figure 11. *Apatobolbina* sp.

Left valve, x22, locality AV2-11.5 m, figured specimen, GSC 72684.

Figures 12-14. *Voronina*? sp.

12. Right valve, ventral view, approximately x22, locality AV1-341 m, figured specimen, GSC 72685.

13. Left valve, dorsal view, approximately x22, locality AV1-341 m, figured specimen, GSC 72686.

14. Right valve, approximately x22, locality AV1-341 m, figured specimen, GSC 72687.

Figure 15. *Yukonibolbina*? sp. 2

Right valve, dorsal view, x30, locality AV2-47 m, figured specimen, GSC 72683.

Figures 16, 17, 28, 30. *Leptobolbina*? sp. 2

16. Right valve, x30, locality AV2-47 m, figured specimen, GSC 72676.

17. Right valve, x22, locality AV3-5 m, figured specimen, GSC 72677.

28. Right valve, x32, locality AV2-11.5 m, figured specimen, GSC 72679.

30. Right valve, steinkern, x35, locality AV1-124.5 m, figured specimen, GSC 72678.

Figure 18. Beyrichiacean indet.

Left valve, heteromorph, x23.5, locality AV2-152 m, figured specimen, GSC 72693.

Figures 20, 21. *Steusloffina*? *symmetrica* n. sp.

20. Carapace, right lateral view, x20.5, locality AV1-341 m, paratype, GSC 72691.

21. Right valve, x23.5, locality AV1-341 m, paratype, GSC 72692.

Figures 22, 23. *Cooperatia lacrimosa* Copeland

22. Left valve, x30, locality AV2-11.5 m, hypotype, GSC 72540.

23. Right valve, x33, locality AV2-47 m, hypotype, GSC 72539.

Figure 24. *Antijanusella spicata* n. sp.

Right valve, x26.5, locality AV1-341 m, paratype, GSC 72607.

Figure 25. *Libumella*? *cardinalis* n. sp.

Carapace, right? lateral view, x25, locality AV2-47 m, paratype, GSC 72682.

Figure 26. *Tubulibairdia* sp.

Interior of right valve, x22, locality AV1-341 m, figured specimen, GSC 72659.

Figure 27. *Bairdiacypris*? sp.

Left valve, x27, locality AV2-152 m, figured specimen, GSC 72681.

Figure 29. *Arcuaria avalanchensis* Copeland

Right valve, x29, locality AV2-11.5 m, hypotype, GSC 72538.

Figure 31. *Aechmina wolfensis* n. sp.

Carapace, left lateral view, specimen lost.

Figure 32. *Craspedobolbina*? sp.

Right valve, x34, locality AV1-124.5 m, figured specimen, GSC 72680.

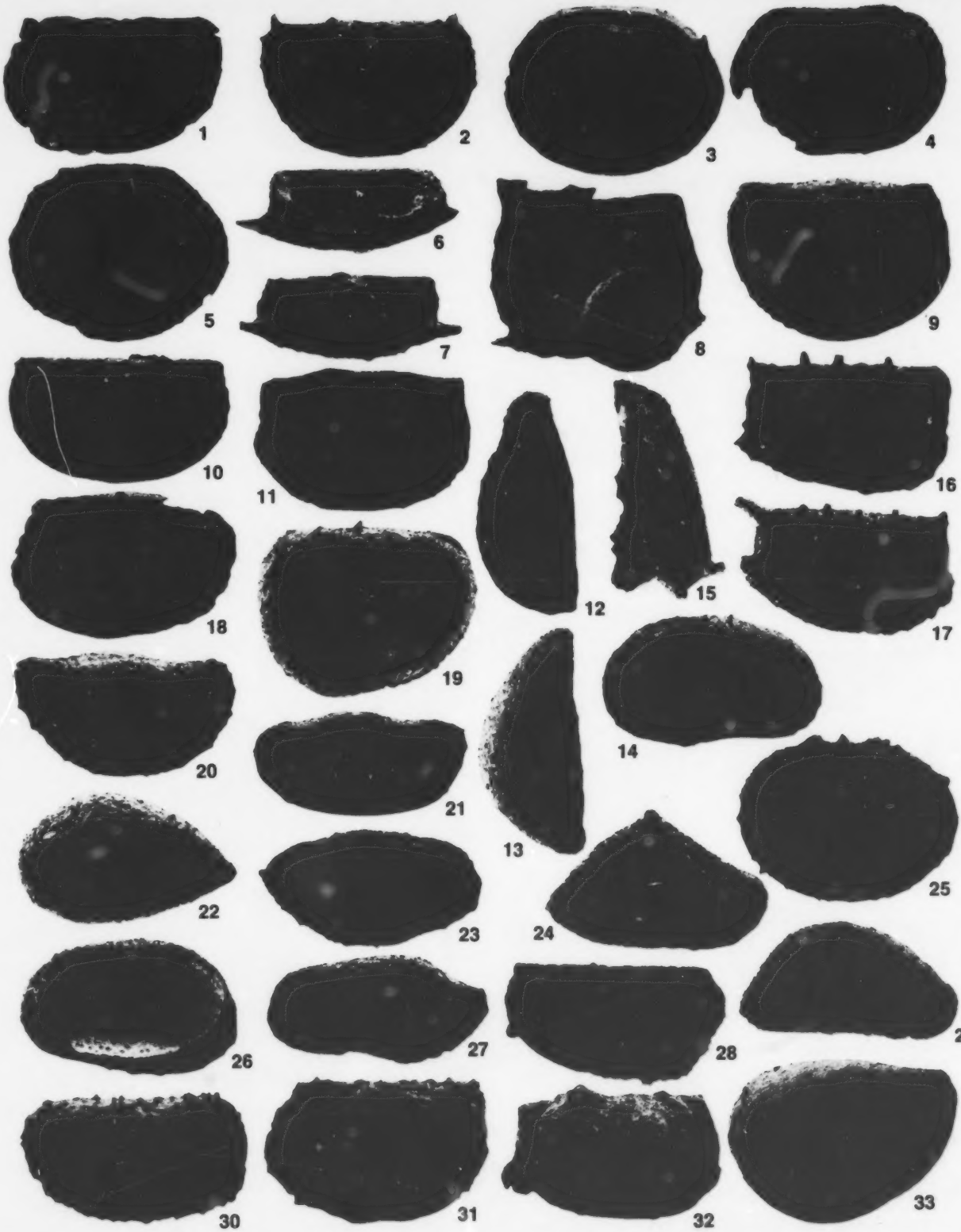
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PLATE 5

Silurian, Delorme Formation
(except figures 21, 24-34: Whittaker Formation)

Figures 1, 2. *Limbinariopsis sinuata* n. sp.

1. Left valve, x33, locality AV1-583.5 m, paratype, GSC 72636.

2. Left valve, x38, locality AV1-592 m, holotype, GSC 72637.

Figures 3, 4. *Venzavella*? sp.

3. Left valve, x57, locality AV1-592 m, figured specimen, GSC 72543.

4. Left valve, x44, locality AV1-583.5 m, figured specimen, GSC 72544.

Figures 5, 6. *Triemilomatella*? sp.

5. Left valve, x42, locality AV2-242 m, figured specimen, GSC 72520.

6. Left valve, x40, locality AV2-242 m, figured specimen, GSC 72521.

Figures 7, 8. *Billingsopsis planivelata* n. sp.

7. Left valve, x33, locality AV2-256 m, holotype, GSC 72522.

8. Left valve, x42, locality AV2-274-9 m, paratype, GSC 72523.

Figures 9-14. *Alaskabolbina trinodosa* n. sp.

9. Left valve, x35, locality AV1-592 m, paratype, GSC 72500.

10. Left valve, x30, locality AV1-583.5 m, paratype, GSC 72501.

11. Right valve, x33, locality AV1-592 m, paratype, GSC 72502.

12. Right valve, interior view, x25, locality AV1-583.5 m, paratype, GSC 72503.

13. Left valve, x30, locality AV1-592 m, paratype, GSC 72504.

14. Right valve, x22, locality AV1-592 m, paratype, GSC 72505.

Figure 15. *Dizygopleura*? *borealis* n. sp.

Interior, right valve, x29, locality AV4-166T m, paratype, GSC 72620.

Figure 16. *Processobairdia delormensis* Copeland

Left valve, x17, locality AV4-136T m, hypotype, GSC 72536.

Figure 17. *Baschkirina*? sp.

Right valve, x17, locality AV1-592 m, figured specimen, GSC 72612.

Figure 18. *Aechminaria equalis* n. sp.

Right valve, x40, locality AV1-583.5 m, paratype, GSC 72519.

Figure 19. *Ovornina* (*Tricornella*) *perryi* Copeland

Right valve, x40, locality AV1-583.5 m, hypotype, GSC 72591.

Figure 20. *Acanthoscapha* sp. cf. *A. decurtata* Bouček

Left valve, x32, locality AV1-592 m, hypotype, GSC 72592.

Figure 21. "*Acanthoscapha*" *dorsicornis* n. sp.

Right valve, x27, locality AV2-47 m, holotype, GSC 72586.

Figures 22, 24. *Ockerella jordani* Copeland

22. Carapace, dorsal view, x42, locality AV1-592 m, hypotype, GSC 72593.

24. Left valve, ventral view, x36, locality AV3-5 m, hypotype, GSC 72590.

Figures 23, 25. *Tricornina* (*Tricornina*) *navicula* Bouček

23. Carapace, ventral view, x27.5, locality AV1-592 m, hypotype, GSC 72609.

25. Left valve, x35, locality AV3-5 m, hypotype, GSC 72578.

Figure 26. *Ockerella longula* n. sp.

Left valve, x35, locality AV3-5, holotype, GSC 72610.

Figures 27-29. *Janusella*? *latispinosa* n. sp.

27. Left valve, x36, locality AV3-5 m, holotype, GSC 72621.

28. Left valve, x33, locality AV2-11.5 m, paratype, GSC 72622.

29. Left valve, x35, locality AV2-11.5 m, paratype, GSC 72623.

Figure 30. *Shidelerites*? *laterospinosus* n. sp.

Carapace, dorsal view, x27, locality AV3-5 m, holotype, GSC 72608.

Figures 31, 32. *Antijanusella spicata* n. sp.

31. Right valve, x36, locality AV2-47 m, holotype, GSC 72605.

32. Right valve, x32, locality AV2-47 m, paratype, GSC 72606.

Figures 33, 34. *Beecherella roddicki* n. sp.

33. Left valve, x29, locality AV2-47 m, paratype, GSC 72594.

34. Left valve, x30, locality AV2-47 m, holotype, GSC 72595.

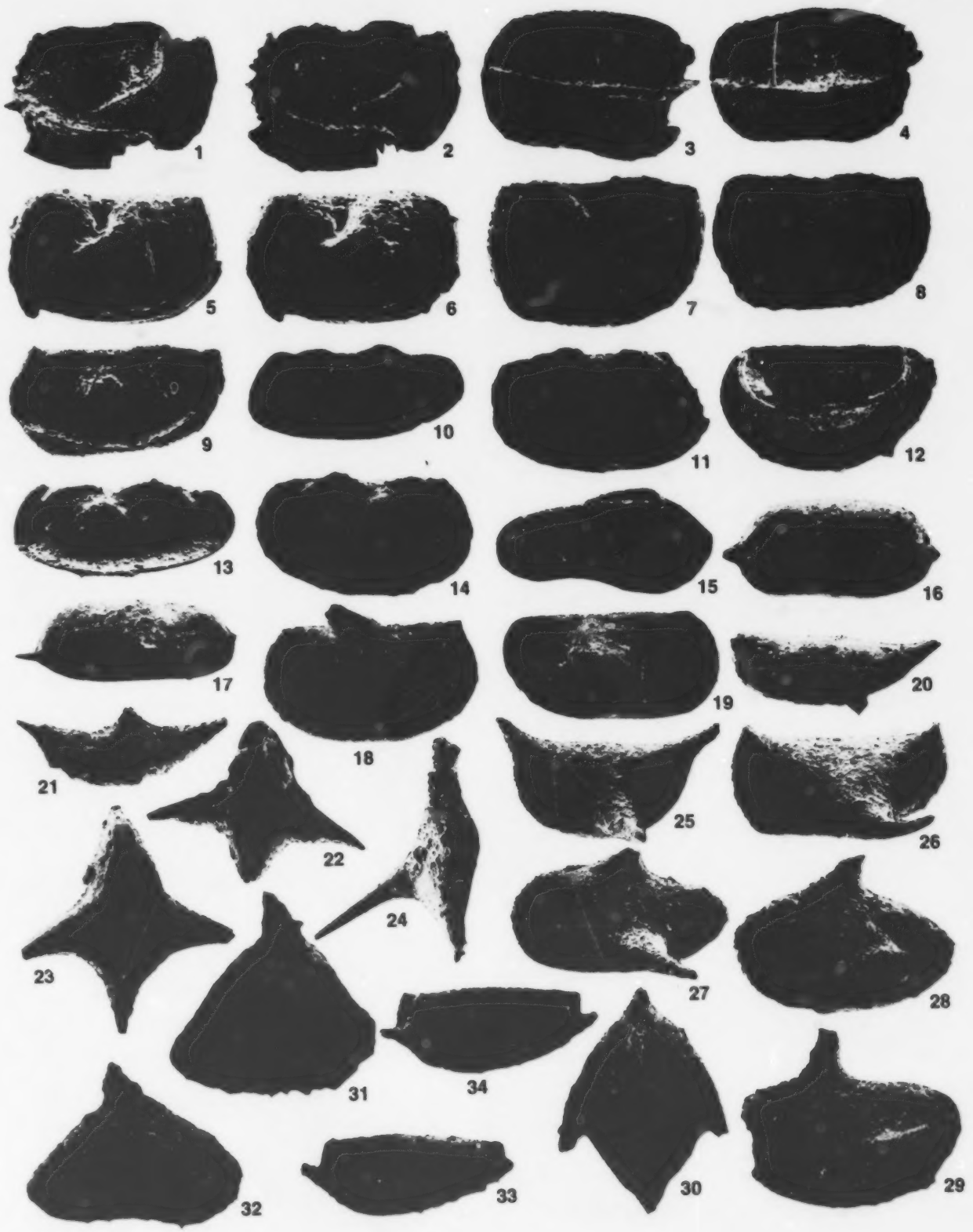
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PLATE 6

Silurian, Whittaker Formation

Figures 1, 2. *Libumella* sp. cf. *L. ambigua* (Lundin)

1. Lateral view, x31, locality AV1-320T m, hypotype, GSC 72511.

2. Lateral view, x30, locality AV1-346 m, hypotype, GSC 72512.

Figure 3. *Libumella*? *cardinalis* n. sp.

Lateral view, x22, locality AV1-346 m, holotype, GSC 72562.

Figure 4. *Medianella*? sp.

Right? valve, x12.5, locality AV1-346 m, figured specimen, GSC 72517.

Figures 5, 6. *Silenis mawii*? (Jones)

5. Left valve, x17.5, locality AV1-336T m, hypotype, GSC 72560.

6. Right valve, x18, locality AV1-336T m, hypotype, GSC 72561.

Figure 7. *Steusloffina*? *symmetrica* n. sp.

Lateral view, x29, locality AV1-320 m, holotype, GSC 72564.

Figure 8. *Tipperopsis quadrilineata* n. sp.

Lateral view, x28.5, locality AV1-336T, holotype, GSC 72563.

Figure 9. *Abditoloculina* sp. cf. *A. triloculata* Copeland

Right valve, x40, locality AV1-336T m, figured specimen, GSC 72709.

Figures 10, 17, 22-27. *Craspedobolbina* (*Mitrobeyrichia*) *siveteri* n. sp.

10. Right valve, interior view, heteromorph, x18.5, locality AV1-346 m, paratype, GSC 72710.

17. Left valve, x19, locality AV1-336T m, paratype, GSC 72711.

22. Ventral view, left valve, heteromorph, x20, locality AV1-320T m, paratype, GSC 72712.

23. Right valve, heteromorph, x21, locality AV1-346 m, paratype, GSC 72713.

24. Interior, right valve, heteromorph, x20, locality AV1-346 m, paratype GSC 72714.

25. Left valve, heteromorph, x16, locality AV1-346 m, holotype, GSC 72715.

26. Right valve, heteromorph, x20, locality AV1-346 m, paratype, GSC 72716.

27. Interior, left valve, heteromorph, showing arcuate scar on crumina, x44, locality AV1-320T m, paratype, GSC 72717.

Figure 11. *Arcuaria avalanchensis* Copeland

Left valve, x21, locality AV1-320T m, hypotype, GSC 72530.

Figures 12-16, 18-21. *Beyrichia* (*Beyrichia*) *keslingi* n. sp.

12. Right valve, x21, locality AV1-336T m, paratype, GSC 72718.

13. Right valve, x23.5, locality AV1-336T m, paratype, GSC 72719.

14. Left valve, x21, locality AV1-336T m, paratype, GSC 72720.

15. Left valve, x33, locality AV1-346T m, paratype, GSC 72721.

16. Right valve, heteromorph, x20, locality AV1-320T m, holotype, GSC 72722.

18. Right valve, ventral view, x21, locality AV1-336T m, paratype, GSC 72723.

19. Left valve, x21, locality AV1-320T m, paratype, GSC 72724.

20. Left valve, heteromorph, x19, locality AV1-346 m, paratype, GSC 72725.

21. Right valve, x21, locality AV1-320T m, paratype, GSC 72726.

Figures 28-30. *Craspedobolbina* (*Mitrobeyrichia*) *lundini* n. sp.

28. Right valve, heteromorph, x16, locality AV1-346 m, paratype, GSC 72727.

29. Right valve, heteromorph, x22, locality AV1-336T m, paratype, GSC 72728.

30. Left valve, heteromorph, x21, locality AV1-346 m, holotype, GSC 72729.

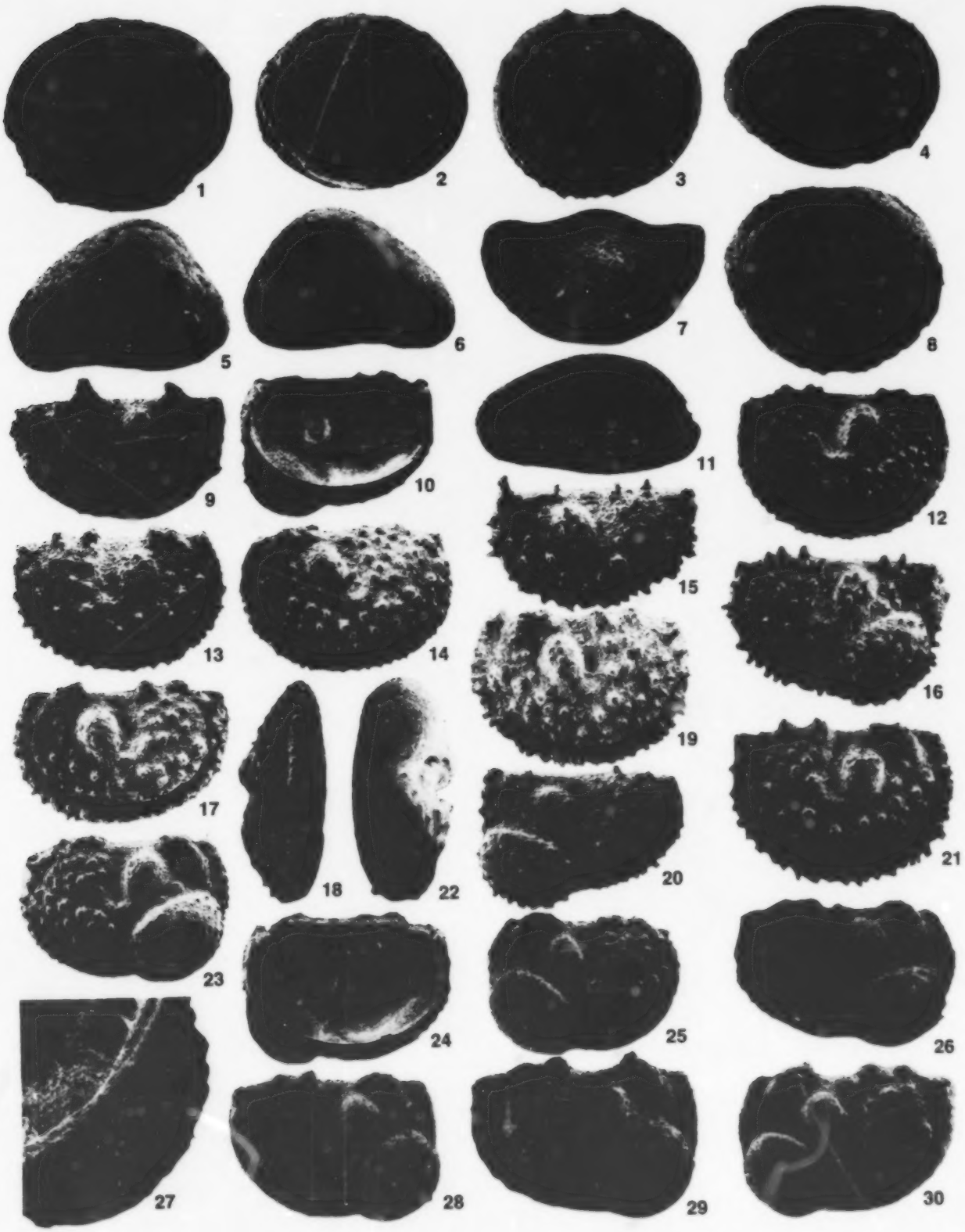
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PLATE 7

Silurian, Delorme Formation

Figures 1-14, 16-32. *Echinobeyrichia spinosa* n. sp.

1. Left valve, x27, locality AV1-589.8 m, paratype, GSC 72731.

2, 3. Left valves, x30 and x25, locality AV4-126T m, paratype, GSC 72732, 72733.

4, 5. Left valves, x21 and x29, locality AV2-256A m, paratypes, GSC 72734, 72735.

6. Left valve, x36, locality AV1-589.8 m, paratype, GSC 72736.

7. Right valve, x25, locality AV2-256A m, paratype, GSC 72737.

8, 9. Right valves, x28.5, locality AV4-126T m, paratypes, GSC 72738, 72739.

10. Right valve, x23.5, locality AV1-589.8 m, paratype, GSC 72740.

11. Right valve, x27, locality AV1-589.8 m, paratype, GSC 72741.

12. Right valve, internal view, x28.5, locality AV1-589.8 m, paratype, GSC 72742.

13, 14. Left valves, heteromorphs, x25, locality AV4-126T m, paratypes, GSC 72743, 72744.

16. Left valve, heteromorph, x25, locality AV2-256A m, paratype, GSC 72746.

17. Right valve, heteromorph, x25, locality AV1-589.8 m, paratype, GSC 72747.

18. Left valve, heteromorph, x23.5, locality AV4-126T m, paratype, GSC 72748.

19. Right valve, heteromorph, x22, locality AV4-126T m, holotype, GSC 72749.

20. Right valve, heteromorph, x22, locality AV1-589.8 m, paratype, GSC 72750.

21. Right valve, heteromorph, x27, locality AV2-256A m, paratype, GSC 72751.

22. Right valve, x30, locality AV4-126T m, paratype, GSC 72752.

23. Right valve, x33, locality AV2-256A m, paratype, GSC 72753.

24. Right valve, x33, locality AV4-126T m, paratype, GSC 72754.

25. Right valve, heteromorph, x30, locality AV1-590 m, paratype, GSC 72755.

26. Right valve, heteromorph, x30, locality AV4-126T m, paratype, GSC 72756.

27. Right valve, heteromorph, x28.5, locality AV4-126T m, paratype, GSC 72757.

28. Right valve, heteromorph, x28.5, locality AV4-126T m, paratype, GSC 72758.

29. Right valve, heteromorph, x27, locality AV4-126T m, paratype, GSC 72759.

30. Right valve, heteromorph, x30, locality AV2-256A m, paratype, GSC 72760.

31. Left valve, heteromorph, x28.5, locality AV4-126T m, paratype, GSC 72761.

32. Left valve, heteromorph, x27, locality AV2-274-279 m, paratype, GSC 72762.

Figure 15. *Beyrichia (Beyrichia) lenzi* Copeland

Left valve, heteromorph, x15, locality AV1-590 m, hypotype, GSC 72745.

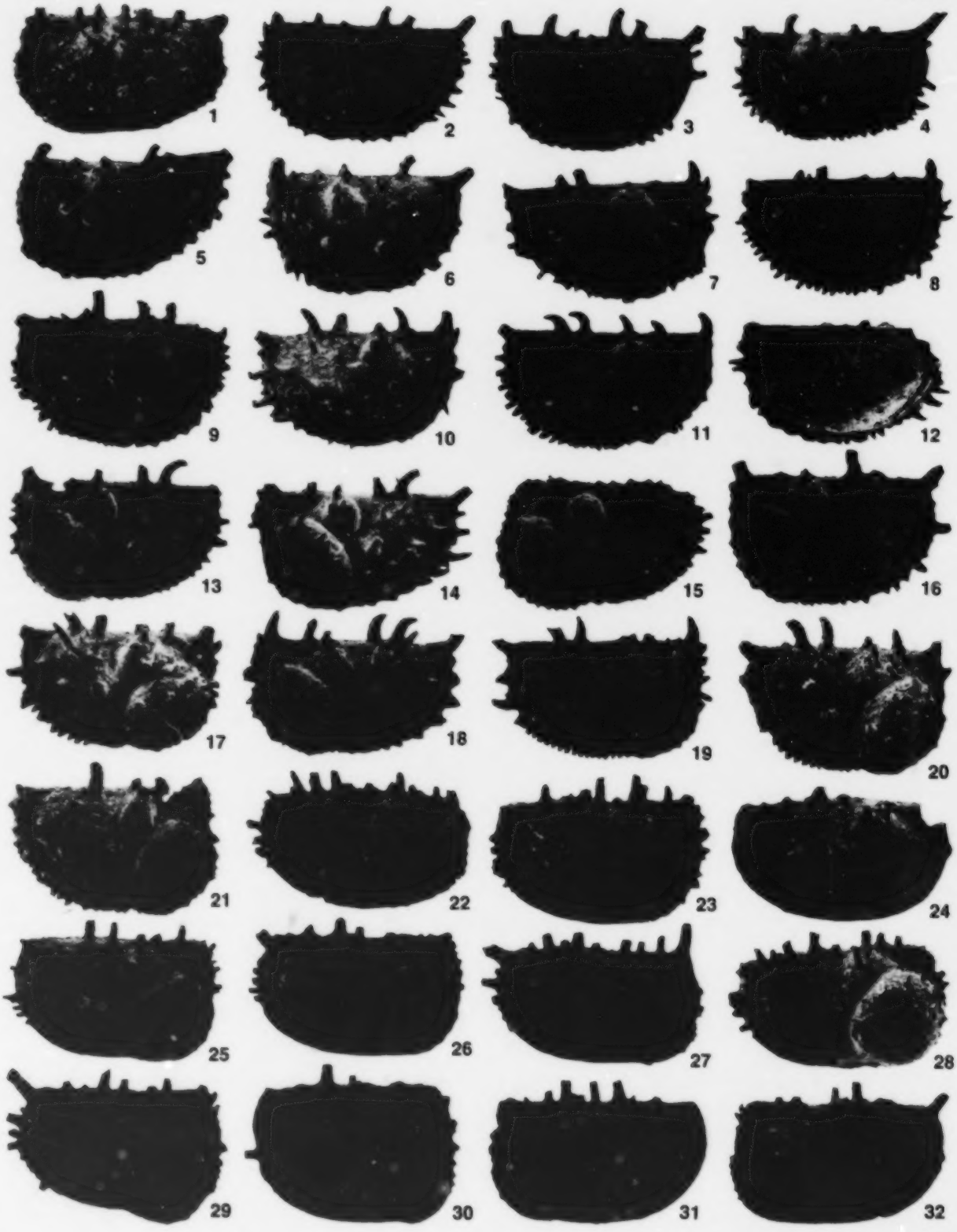
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PLATE 8

Silurian, Delorme Formation

Figure 1. Beyrichiacean indet. 3

Right valve, x20, locality AV1-586.1 m, figured specimen, GSC 72708.

Figure 2. *Kiesowia? decinodosa* n. sp.

Right valve, x33, locality AV4-126T m, paratype, GSC 72556.

Figure 3. *Kolmodinia spinosa* Copeland

Right valve, x32, locality AV4-126T m, holotype, GSC 72628.

Figure 4. *Stroterobolbina?* sp.

Right valve, x21, locality AV2-256 m, figured specimen, GSC 72707.

Figures 5, 6. *Comikloedenina? tuberculata* n. sp.

5. Left valve, heteromorph, x32, locality AV4-126T m, paratype, GSC 72525.

6. Left valve, x31, locality AV4-107 m, paratype, GSC 72526.

Figures 7, 8. *Abditoloculina triloculata* Copeland

7. Right valve, x44, locality AV4-126T m, hypotype, GSC 72557.

8. Left valve, heteromorph, x44, locality AV1-589.8 m, hypotype, GSC 72558.

Figures 9-12. *Pseudobeyrichia cristata* n. sp.

9. Left valve, x33, locality AV2-274-279 m, paratype, GSC 72624.

10. Left valve, x40, locality AV2-256A m, paratype, GSC 72625.

11. Left valve, heteromorph, x30, locality AV4-126T m, holotype, GSC 72626.

12. Left valve, x60, locality AV1-590 m, paratype, GSC 72627.

Figure 13. *Nudista* sp.

Left valve, heteromorph, x22, locality AV1-589.8 m, figured specimen, GSC 72702.

Figures 14, 15, 17-20, 23, 24. *Eoflaccivelum blussoni* n. sp.

14. Right valve, heteromorph, x30, locality AV1-589.8 m, holotype, GSC 72545.

15. Left valve, tecnomorph, x36, locality AV4-126T m, paratype, GSC 72546.

17. Left valve, tecnomorph, x28.5, locality AV1-589.8 m, paratype, GSC 72547.

18, 19. Right valves, tecnomorphs, x25, locality AV4-126T m, paratypes, GSC 72548, 72549.

20. Left valve, x25, locality AV4-126T m, paratype, GSC 72550.

23. Left valve, x24, locality AV4-126T m, paratype, GSC 72551.

24. Right valve, x28.5, locality AV1-589.8 m, paratype, GSC 72552.

Figure 16. Palaeocopid indet. 1

Left valve, x30, locality AV4-126T m, figured specimen, GSC 72706.

Figures 21, 22. *Gabrielsella reticulata* n. sp.

21. Right valve, x33, locality AV1-590 m, paratype, GSC 72480.

22. Left valve, x32, locality AV1-586.1 m, paratype, GSC 72481.

Figures 25-31. *Avalanchella bicristata* n. sp.

25. Left valve, x30, locality AV1-590 m, paratype, GSC 72459.

26. Left valve, x47, locality AV1-589.8 m, paratype, GSC 72455.

27. Left valve, x36, locality AV1-589.8 m, paratype, GSC 72456.

28. Left valve, x36, locality AV1-589.8 m, paratype, GSC 72457.

29. Right valve, x36, locality AV1-586.1 m, paratype, GSC 72454.

30. Right valve, x28.5, locality AV1-589.8 m, paratype, GSC 72458.

31. Right valve, x33.5, locality AV1-590 m, paratype, GSC 72460.

Figure 32. *Avalanchella bicristata micropunctata* n. ssp.

Right valve, x23.5, locality AV1-589.8 m, paratype, GSC 72471.

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PLATE 9

Silurian, Delorme Formation

Figure 1. *Avalanchella bicristata micropunctata* n. ssp.

Left valve, heteromorph, x23, locality AV2-274-279 m, holotype, GSC 72470.

Figures 2-8, 10. *Avalanchella bicristata* n. sp.

2. Left valve, heteromorph, x27, locality AV2-274-279 m, paratype, GSC 72467.

3. Left valve, heteromorph, x27, locality AV2-256A m, paratype, GSC 72464.

4. Right valve, heteromorph, x27, locality AV4-126T m, holotype, GSC 72453.

5. Left valve, heteromorph, x26, locality AV2-256A m, paratype, GSC 72462.

6, 7. Left valves, x36, locality AV2-274-279 m, paratypes, GSC 72466, 72465.

8. Left valve, x30, locality AV2-256A m, paratype, GSC 72463.

10. Carapace, ventral view, x36, locality AV1-590 m, paratype, GSC 72461.

Figures 9, 13-15. *Gabrielsella reticulata* n. sp.

9. Right valve, x36, locality AV2-274-279 m, paratype, GSC 72482.

13. Left valve, heteromorph, x33, locality AV2-256A m, paratype, GSC 72479.

14. Right valve, x33, locality AV2-274-279 m, paratype, GSC 72483.

15. Right valve, heteromorph, x33, locality AV4-126T m, holotype, GSC 72478.

Figures 11, 12, 16, 18. *Camsella nodosa* n. sp.

11. Left valve, heteromorph, x30, locality AV4-126T m, holotype, GSC 72472.

12. Left valve, heteromorph, x30, locality AV4-126T m, paratype, GSC 72473.

16. Right valve, x44, locality AV4-165T m, paratype, GSC 72474.

18. Right valve, x50, locality AV4-165T m, paratype, GSC 72475.

Figures 17, 19, 23, 27. *Undulirete mackenziensis* Copeland

17. Right valve, x57, locality AV2-274-279 m, hypotype, GSC 72487.

19. Left valve, x50, locality AV2-256A m, hypotype, GSC 72488.

23. Left valve, x50, locality AV2-274-279 m, hypotype, GSC 72489.

27. Left valve, x44, locality AV4-165T m, hypotype, GSC 72490.

Figure 20. *Signetopsis reticulata* n. sp.

Right valve, x44, locality AV2-274-279 m, holotype, GSC 72491.

Figures 21, 22, 24, 25, 28, 29. *Alaskabolbina trinodosa* n. sp.

21. Left valve, x28.5, locality AV2-274-279 m, paratype, GSC 72492.

22. Left valve, x28.5, locality AV2-274-279 m, holotype, GSC 72493.

24, 25. Right valves, x40 and x44 broken., locality AV2-274-279 m, paratypes, GSC 72494, 72495.

28. Left valve, x23, locality AV4-126T m, paratype, GSC 72496.

29. Left valve, x50, locality AV2-274-279 m, paratype, GSC 72497.

Figure 26. *Yukonibolbina*? sp. 1.

Right valve, x19, locality AV2-274-279 m, figured specimen, GSC 72506.

Figure 30. *Apatobolbina*? sp.

Left valve, heteromorph, x36, locality AV4-107 m, figured specimen, GSC 72486.

Figure 31. *Dolichoscapha minuta* n. sp.

Left valve, heteromorph, x40, locality AV4-165 m, paratype, GSC 72485.

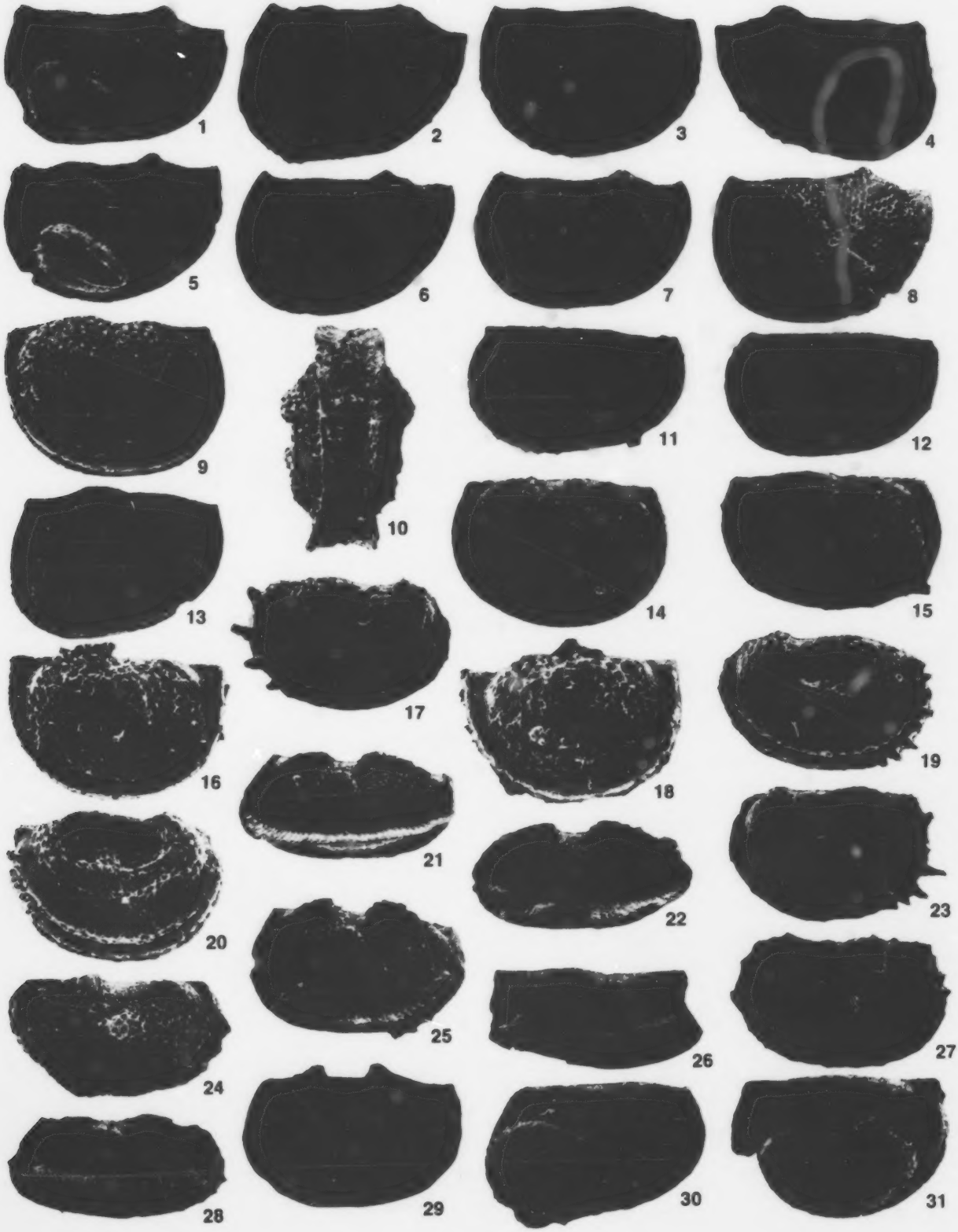
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PLATE 10

Silurian, Delorme Formation
(except figure 21: Whittaker Formation)

Figures 1-14. *Beyrichia (Beyrichia) lenzi* Copeland

1. Right valve, heteromorph, x19, locality AV2-256A m, hypotype, GSC 72660.
2. Left valve, interior view, heteromorph, x21, locality AV4-107 m, hypotype, GSC 72661.
3. Left valve, x30, locality AV2-256A m, hypotype, GSC 72662.
4. Right valve, x20, locality AV2-256A m, hypotype, GSC 72663.
5. Right valve, oblique interior view, heteromorph, x15.5, locality AV1-583.5 m, hypotype, GSC 72664.
6. Right valve, x16, locality AV1-586.1 m, hypotype, GSC 72665.
7. Left valve, x16, locality AV1-589.8 m, hypotype, GSC 72666.
8. Right valve, x21, locality AV2-247-279 m, hypotype, GSC 72667.
9. Right valve, x29, locality AV1-598.8 m, hypotype, GSC 72668.
10. Left valve, x30, locality AV1-590 m, hypotype, GSC 72669.
11. Right valve, x20, locality AV1-590 m, hypotype, GSC 72670.
12. Right valve, x21, locality AV1-586.1 m, hypotype, GSC 72671.
13. Right valve, x29? (broken), locality AV1-589.8 m, hypotype, GSC 72672.
14. Left valve, x29, locality AV1-589.8 m, hypotype, GSC 72673.

Figure 15. *Dolichoscapha minuta* n. sp.

Right valve, heteromorph, x40, locality AV4-166T m, holotype, GSC 72484.

Figure 16. *Lomatobolbina*? sp.

Right valve, x30, locality AV2-256A m, figured specimen, GSC 72701.

Figure 17. *Welleriopsis*? sp.

Carapace, right lateral view, x29, locality AV2-256A m, figured specimen, GSC 72703.

Figures 18-20. *Eoflaccivelum blussoni* n. sp.

18. Left valve, tecnomorph, x30, locality AV2-274-279 m, paratype, GSC 72553.
19. Right valve, tecnomorph, x25, locality AV2-256A m, paratype, GSC 72554.
20. Right valve, tecnomorph, x23.5, locality AV2-274-279 m, paratype, GSC 72555.

Figure 21. *"Rozhdestvenskayites"* sp. cf. *"R." auriculiferus* Rozhdestvenskaya

Carapace, left lateral view, x22, locality AV3-5 m, hypotype, GSC 72674.

Figure 22. *Nudista* sp.

Left valve, heteromorph, x22, locality AV2-256A m, figured specimen, GSC 72700.

Figures 23, 24. *Avalanchella bicristata* n. sp.

23, 24. Left valves, x30, locality AV1-583.5 m, paratypes, GSC 72468, 72469.

Figure 25. *Berounella spicata* n. sp.

Right valve, x36 locality AV1-592 m, holotype, GSC 72508.

Figure 26. *Kirkbyella (Berdanella) belli* n. sp.

Left valve, x44, locality AV1-583.5 m, holotype, GSC 72510.

Figures 27, 28, 32. *Camsella nodosa* n. sp.

27. Left valve, x36, locality AV1-592 m, paratype, GSC 72476.
28. Right valve, x36, locality AV1-583.5 m, paratype, GSC 72477.
32. Broken right valve?, x40, locality AV4-166T m, paratype, GSC 72675.

Figures 29-31. *Dizygopleura*? *borealis* n. sp.

29. Carapace, ventral view, x28.5, locality AV4-166T m, holotype, GSC 72617.
30. Carapace, dorsal view, x30, locality AV4-166T m, paratype, GSC 72618.
31. Left valve, x28.5, locality AV4-166T m, paratype, GSC 72619.

Figure 33. *Libumella* sp. indet.

Interior left? valve, x34, locality AV2-242 m, figured specimen, GSC 72704.

Figure 34. *Abditoloculina triloculata* Copeland

Right valve, x44, locality AV2-274-279 m, hypotype, GSC 72559.

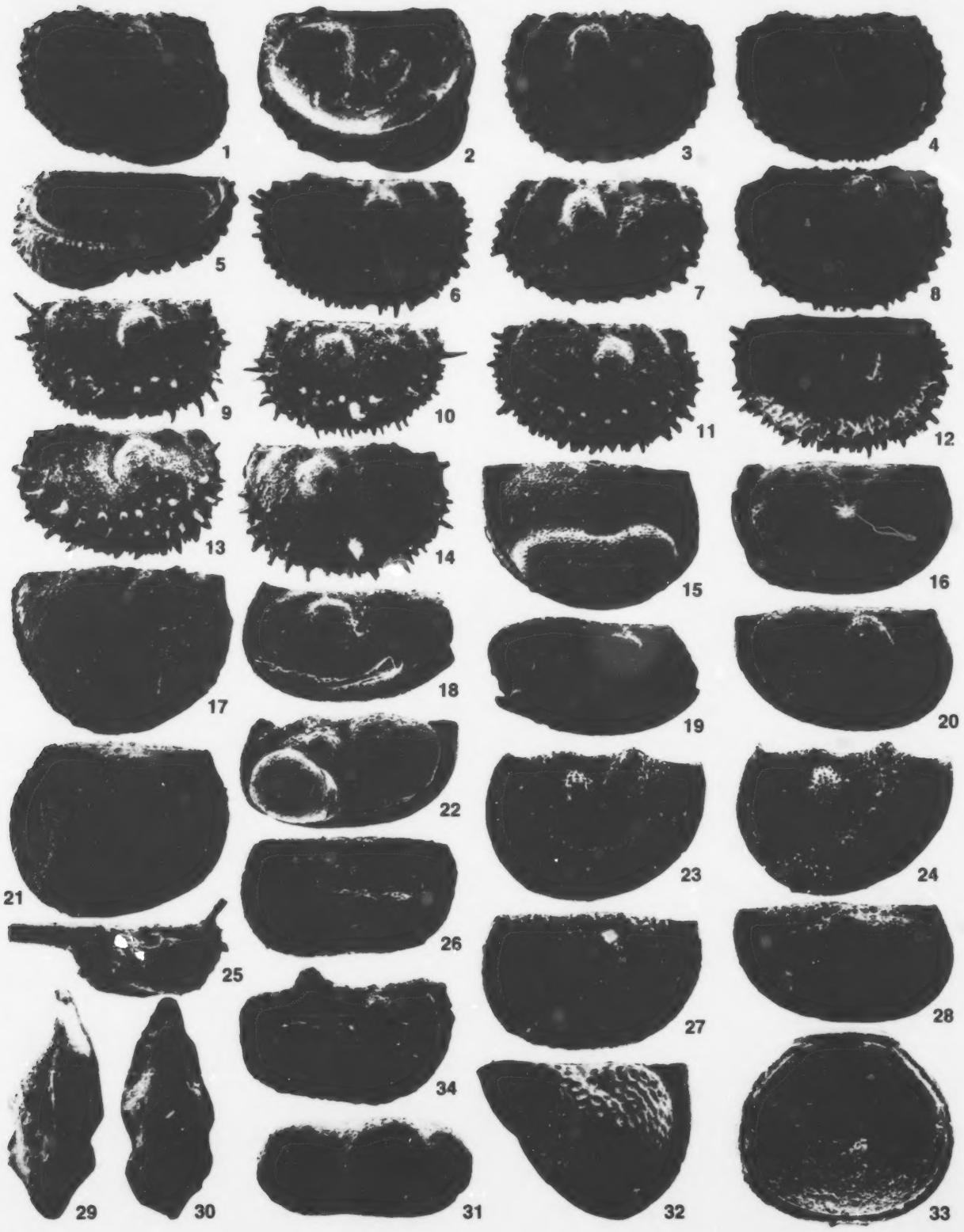
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PLATE 11

Silurian, Delorme Formation
(except figures 1, 2: Whittaker Formation)

Figures 1, 2. Beyrichiacean indet. 2

1. Right valve, heteromorph, x17, locality AV3-155T m, figured specimen, GSC 80908.

2. Left valve, x20, locality AV3-155T m, figured specimen, GSC 80909.

Figures 3, 4. *Abditoloculina triloculata* Copeland

3. Right valve, ventral view, x35, locality AV4-126T m, hypotype, GSC 80822.

4. Left valve, interior view, x50, locality AV4-126T m, hypotype, GSC 80823.

Figures 5, 6. *Eoflaccivelum blussoni* n. sp.

5, 6. Left valves, approximately x30, locality AV3-155T m, paratypes, GSC 80911, 80910.

Figures 7-9. *Delormobolbina binodosa* n. sp.

7. Left valve, lateral view, x46, locality AV4-126T m, paratype, GSC 80858.

8. Left valve, ventral view, x32, locality AV4-126T m, paratype, GSC 80859.

9. Left valve, dorsal view, x30, locality AV4-126T m, paratype, GSC 80860.

Figure 10. *Alaskabolbina trinodosa* n. sp.

Right valve, interior view, x55, locality AV4-126T m, paratype, GSC 80857.

Figures 11, 12. *Delormobolbina binodosa* n. sp.

11. Right valve, x35, locality AV4-126T m, paratype, GSC 80861.

12. Right valve, x48, locality AV4-126T m, holotype, GSC 80862.

Figures 13, 14. *Polenovula rara* n. sp.

13. Carapace, ventral view, x30, locality AV1-583.5 m, paratype, GSC 80855.

14. Left valve, x28, locality AV1-586 m, paratype, GSC 80856.

Figure 15. *Beyrichia* (*Simplicibeyrichia*) sp. 1

Left valve, x33, locality AV4-126T m, figured specimen, GSC 80863.

Figure 16, 18-20. *Dolichoscapha minuta* n. sp.

16. Left valve, heteromorph, x58, locality AV4-126T m, paratype, GSC 80894.

18. Left valve, x43, locality AV4-126T m, paratype, GSC 80935.

19. Left valve, x56, locality AV4-240 m, paratype, GSC 80844.

20. Left valve, x60, locality AV4-126T m, paratype, GSC 80845.

Figure 17. *Gabrielsella reticulata* n. sp.

Left valve, x34, locality AV4-126T m, paratype, GSC 80840.

Figures 21, 22. *Kirkbyella* (*Berdanella*) *belli* n. sp.

21. Right valve, x60, locality AV1-589.8 m, paratype, GSC 72849.

22. Left valve, x37.5, locality AV1-589.8 m, paratype, GSC 72850.

Figure 23. *Kolmodinia martinssoni* Copeland

Right valve, x25, locality AV2-255-260 m, holotype, GSC 80852.

Figures 24-26. *Camsella nodosa* n. sp.

24. Right valve, ventral view, heteromorph, x30, locality AV4-126T m, paratype, GSC 80841.

25. Right valve, dorsal view, x30, locality AV1-583.5 m, paratype, GSC 80842.

26. Left valve, ventral view, x19, locality AV4-126T m, paratype, GSC 80843.

Figure 27. *Welleriella*? sp.

Left valve, heteromorph, x28, locality AV1-589.8 m, figured specimen, GSC 80939.

Figures 28, 29. *Dolichoscapha* sp. cf. *D. minuta* n. sp.

28, 29. Left valve, interior view, heteromorph, x60 and x115, locality AV4-126T m, figured specimen, GSC 80846.

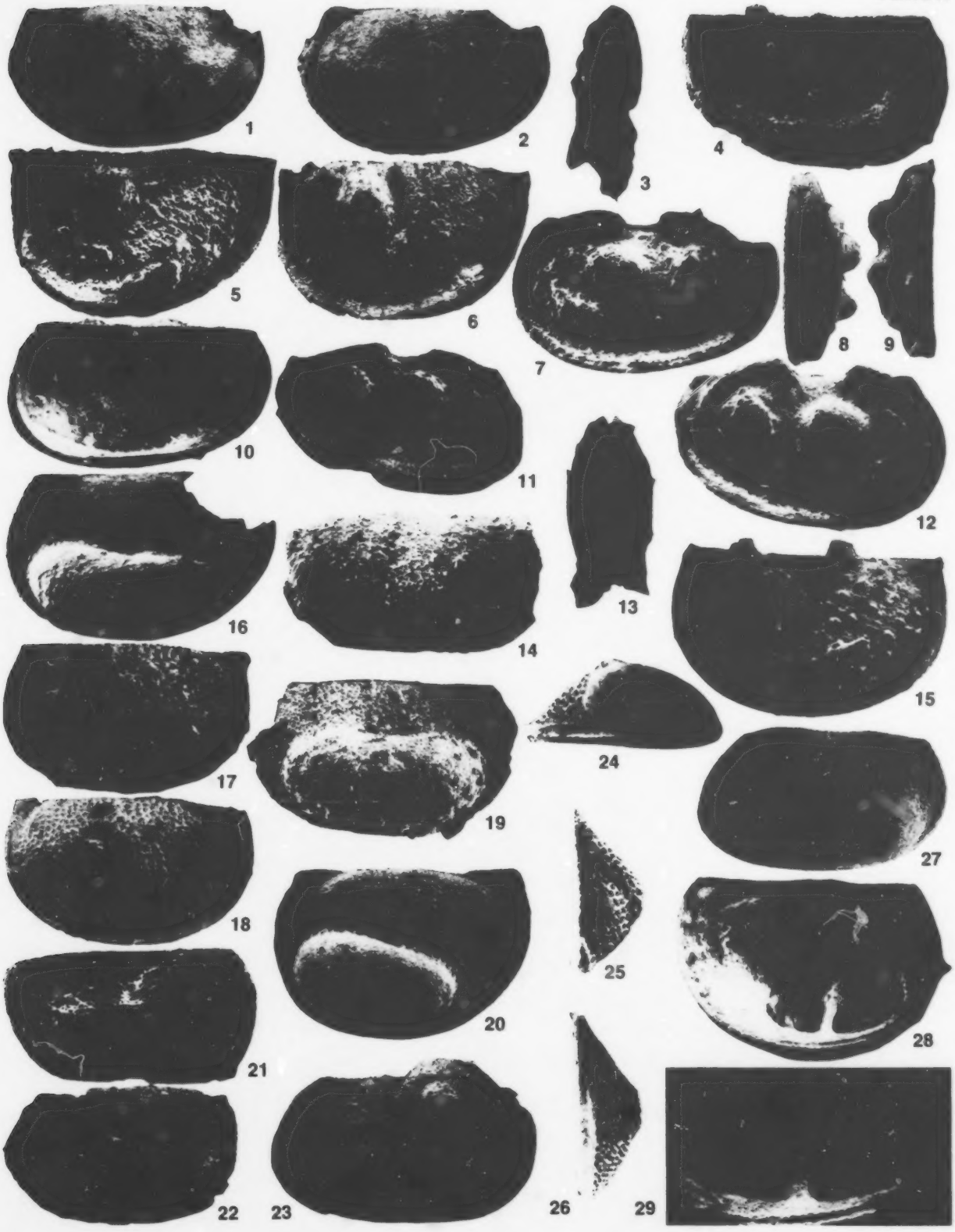
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PLATE 12

Silurian

Figure 1. *Avalanchella bicristata* n. sp.

Right valve, heteromorph wth aborted crumina, x30, locality AV1-590 m, Delorme Formation, paratype, GSC 72848.

Figure 2. *Abditoloculina*? sp.

Left valve, heteromorph, x38, locality AV1-320 m, Whittaker Formation, figured specimen, GSC 80870.

Figures 3, 4. ?Palaeocopid indet. 3

3, 4. Right valve, lateral and interior views, x56 and x60, locality AV4-126T m, Delorme Formation, figured specimen, GSC 80871.

Figure 5. *Gabrielsella reticulata* n. sp.

Left valve, interior view, x46, locality AV3-155T m, Whittaker Formation, paratype, GSC 80942.

Figure 6. *Nudista* sp.

Left valve, ventral view, heteromorph, x21, locality AV4-126T m, Delorme Formation, figured specimen, GSC 80938.

Figure 7. *Leptobolbina*? sp. 1

Left valve, ventral view, heteromorph, x22.5, locality AV1-341 m, Whittaker Formation, figured specimen, GSC 80878.

Figure 8. *Dolichoscapha minuta* n. sp.

Left valve, ventral view, heteromorph, x46, locality AV4-126T m, Delorme Formation, paratype, GSC 80940.

Figure 9. *Winchellatia berdanae* n. sp.

Left valve, x36, locality AV1-589.8 m, Delorme Formation, holotype, GSC 80941.

Figure 10. *Yukonibolbina*? sp. 1

Left valve, x25, locality AV3-60 m, Whittaker Formation, figured specimen, GSC 80872.

Figure 11. *Beyrichia* (*Simplicibeyrichia*) sp. 2

Right valve, x46, locality AV1-592 m, Delorme Formation, figured specimen, GSC 80864.

Figures 12, 15. *Beyrichia* (*Beyrichia*) *keslingi* n. sp.

12. Right valve, x34, locality AV3-60 m, Whittaker Formation, paratype, GSC 80865.

15. Left valve, x30, locality AV3-60 m, Whittaker Formation, paratype, GSC 80868.

Figures 13, 14, 16. *Echinobeyrichia spinosa* n. sp.

13. Left valve, x33.5, locality AV1-590 m, Delorme Formation, paratype, GSC 80866.

14. Left valve, x33, locality AV2-255-260 m, Delorme Formation, paratype, GSC 80867.

16. Right valve, dorsal, x23, locality AV1-586 m, Delorme Formation, paratype, GSC 80869.

Figure 17. *Pseudorayella*? sp.

Left valve (broken), x30, locality AV3-60 m, Whittaker Formation, figured specimen, GSC 80943.

Figure 18. *Berdanopsis royalensis* Copeland

Left valve, x 35.5, locality AV3-155T m, Whittaker Formation, hypotype, GSC 80944.

Figure 19. *Alaskabolbina*? sp.

Right valve, x45.5, locality AV1-630 m, Delorme Formation, figured specimen, GSC 80945.

Figures 20-28. *Beecherella rhomboidalis* n. sp.

20-22. Right valve, interior views, x43, x90, x90, locality AV4-126T m, Whittaker Formation, paratype, GSC 80814.

23. Left valve, interior view, x44.5, locality AV4-126T m, Whittaker Formation, paratype, GSC 80815.

24, 26. Right valve, lateral and dorsal views, x43, locality AV4-126T m, Whittaker Formation, paratype, GSC 80816.

25, 28. Left valve, lateral and ventral views, x42 and x44, locality AV4-126T m, Whittaker Formation, paratype, GSC 80817.

27. Right valve, ventral view, x42, locality AV4-126T m, Whittaker Formation, paratype, GSC 80818.

Figures 29-31. *Kiesowia*? *decinodosa* n. sp.

29. Left valve, x35.5, locality AV2-255-260 m, Delorme Formation, paratype, GSC 72851.

30, 31. Right valve, x37.5 and detail of anterodorsal spine, x225, locality AV4-126T m, Delorme Formation, holotype, GSC 72852.

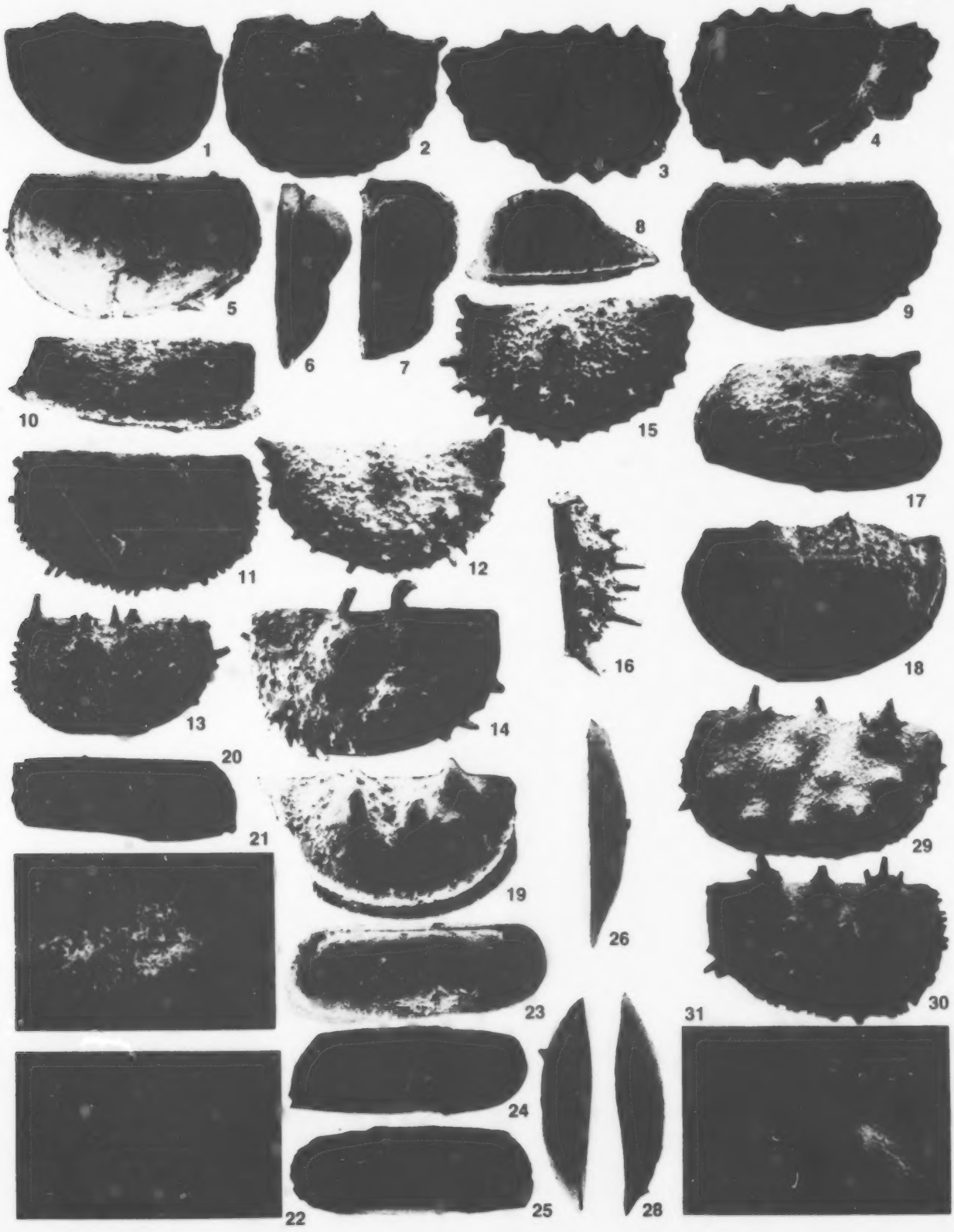
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PLATE 13

Silurian, Delorme Formation

Figures 1-10. *Eoacantonodella zaspelovae* n. sp.

1. Left valve, x67, locality AV4-126T m, paratype, GSC 80912.
2. Left valve, x42, locality AV4-126T m, paratype, GSC 80913.
3. Right valve, ventral view, x32, locality AV4-128T m, paratype, GSC 80914.
4. Right valve, ventral view, x53, locality AV4-126T m, paratype, GSC 80915.
5. Right valve, x50, locality AV4-126T m, paratype, GSC 80916.
6. Left valve, x50, locality AV4-126T m, paratype, GSC 80917.
7. Left valve, x40, locality AV4-126T m, holotype, GSC 80918.
8. Left valve, dorsal view, x36, locality AV4-126T m, paratype, GSC 80919.
9. Right valve, interior view, x47, locality AV4-126T m, paratype, GSC 80920.
10. Left valve, x40, locality AV4-126T m, paratype, GSC 80921.

Figure 11. *Venzavella*? sp.

Left valve, x50, locality AV1-595 m, figured specimen, GSC 80922.

Figures 12-15. *Spinosteusloffina multispinosa* n. sp.

12. Left valve, dorsal view, x50, locality AV4-126T m, paratype, GSC 80923.
13. Right valve, x50, locality AV4-126T m, holotype, GSC 80924.
14. Left valve, ventral view, x48, locality AV4-126T m, paratype, GSC 80925.
15. Left valve, x60, locality AV4-126T m, paratype, GSC 80926.

Figure 16. *Signetopsis reticulata* n. sp.

Left valve, x55, locality AV4-126T m, paratype, GSC 80927.

Figure 17. *Primitiella* sp. 1

Left valve, x50, locality AV1-583.5 m, figured specimen, GSC 80934.

Figures 18-22. *Cornikloedenina*? *tuberculata* n. sp.

18. Left valve, x32, locality AV1-586.1 m, holotype, GSC 80847.
19. Left valve, interior view, x50, locality AV1-583.5 m, paratype, GSC 80848.
20. Carapace, ventral view, x37, locality AV1-583.5 m, paratype, GSC 80849.
21. Carapace, left lateral view, x40, locality AV1-583.5 m, paratype, GSC 80850.
22. Carapace, right lateral view, x40, locality AV1-583.5 m, paratype, GSC 80851.

Figure 23. *Berdanopsis ursensis* Copeland

Carapace, right lateral view, x50, locality AV1-590 m, paratype, GSC 80929.

Figures 24-26. *Berdanopsis*? *planus* n. sp.

24. Right valve, x32, locality AV1-590 m, paratype, GSC 80930.
25, 26. Right valve, x32, locality AV2-274-279 m, holotype, GSC 80931; stereopair.

Figures 27, 28. *Winchellatia*? sp.

27. Right valve, ventral view, x38, locality AV1-583.5 m, figured specimen, GSC 80932.
28. Right valve, x52, locality AV1-592 m, figured specimen, GSC 80933.

Figure 29. *Cryptolopholobus* sp.

Left valve, x38, locality AV1-592 m, figured specimen, GSC 80928.

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PLATE 14

Silurian

Figures 1, 2. *Bairdiocypris longus* Pranskevičius

1, 2. Left valve, detail of hinge, x110, and interior view, x40, locality AV2-157 m, Delorme Formation, hypotype, GSC 80835.

Figures 3-5. *Silenis proteus* Pranskevičius

3, 4. Left valve, detail of hinge, x50, and interior view, x27, locality AV2-157 m, Delorme Formation, hypotype, GSC 80833.

5. Right valve, x18, locality AV2-157 m, Delorme Formation, hypotype, GSC 80834.

Figures 6, 7. *Microcheilinella* sp.

6. Carapace, ventral view, x47, locality AV2-157 m, Delorme Formation, figured specimen, GSC 80906.

7. Left valve, ventral view, x40, locality AV2-157 m, Delorme Formation, figured specimen, GSC 80907.

Figure 8. *Dolichoscapha minuta* n. sp.

Right valve, heteromorph, x60, locality AV2-157 m, Delorme Formation, paratype, GSC 80898.

Figures 9-19. *Perrybolbina bicuspidata* n. sp.

9. Left valve, x60, locality AV2-256A m, Delorme Formation, paratype, GSC 80802.

10. Left valve, specimen lost, x45, locality AV3-60 m, Delorme Formation.

11. Left valve, heteromorph, x32, locality AV2-157 m, Delorme Formation, holotype, GSC 80803.

12. Right valve, x50, locality AV3-155T m, Delorme Formation, paratype, GSC 80804.

13. Left valve, heteromorph, x39, locality AV3-60 m, Whittaker Formation, paratype, GSC 80805.

14. Left valve, x50, locality AV3-155T m, Delorme Formation, paratype, GSC 80806.

15. Left valve, velum deflected at mid venter and eliminated posteriorly, x35, locality AV3-60 m, Whittaker Formation, paratype, GSC 80807.

16. Carapace, right lateral view, x50, locality AV3-155T m, Delorme Formation, paratype, GSC 80808.

17. Left valve, x50, locality AV3-155T m, Delorme Formation, paratype, GSC 80809.

18. Right valve, interior view, heteromorph, x36, locality AV3-60 m, Whittaker Formation, paratype, GSC 80810.

19. Right valve, velum deflected mid ventrally but continuous posteriorly, x40, locality AV3-60 m, Whittaker Formation, paratype, GSC 80811.

Figures 20, 22. Drepanellid indet. 2

20. Left valve, x35, locality AV1-421 m, Whittaker Formation, figured specimen, GSC 80897.

22. Left valve, x50, locality AV1-421 m, Whittaker Formation, figured specimen, GSC 80896.

Figure 21. Drepanellid indet. 1

Right valve, x36, locality AV2-9 m, Whittaker Formation, figured specimen, GSC 80895.

Figures 23-25. Primitiopsid? indet.

23. Carapace, ventral view, (anterior to right), x25, locality AV3-60 m, Whittaker Formation, figured specimen, GSC 80836.

24. Carapace, right lateral view, x37, locality AV3-60 m, Whittaker Formation, figured specimen, GSC 80837.

25. Carapace, dorsal view, x32, locality AV3-60 m, Whittaker Formation, figured specimen, GSC 80838.

Figure 26. *Libumella* sp. cf. *L. ambigua* (Lundin)

Carapace, ventral view, x23, locality AV2-255-260 m, Delorme Formation, hypotype, GSC 80839.

Figures 27, 28. *Gabrielsella reticulata* n. sp.

27. Left valve, interior view, x37, locality AV3-155T m, Delorme Formation, paratype, GSC 80899.

28. Left valve, x44, locality AV3-155T m, Delorme Formation, paratype, GSC 80905.

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PLATE 15

Silurian, Whittaker Formation
(All specimens from locality AV2-157 m)

Figures 1-3. *"Acanthoscapha" dorsiglobosa* n. sp.

1. Right valve, x36, paratype, GSC 80828.
2. Right valve, interior view, x37, paratype, GSC 80829.
3. Left valve, interior view, x32, paratype, GSC 80830.

Figures 4-6. *Tubulibairdia* sp.

4. Right valve, x60, figured specimen, GSC 80900.
5. Left valve, ventral view, x52, figured specimen, GSC 80901.
6. Right valve, interior view, x64, figured specimen, GSC 80902.

Figure 7. *Libumella marginata* Copeland

Left valve, x48, hypotype, GSC 80903.

Figures 8, 9. *Libumella* sp. cf. *L. ambigua* (Lundin)

8. Lateral view, x50, hypotype, GSC 72598.
9. Internal view, x45, hypotype, GSC 80801.

Figure 10. *Apatobolbina elongidolonata* n. sp.

Left valve, x45.5, paratype, GSC 80904.

Figures 11, 12. *Perrybolbina bicuspidata* n. sp.

11. Carapace, ventral view, x90, paratype, GSC 80812.
12. Left valve, x90, paratype, GSC 80813.

Figures 13-15. *Arcuaria delormensis* Copeland

13. Right valve, interior view, x35, hypotype, GSC 80819.
14. Carapace, right lateral view, x32, hypotype, GSC 80820.
15. Carapace, right lateral view, x38, hypotype, GSC 80821.

Figures 16, 17. *Paranoviportia*? sp.

16. Right valve, x60, figured specimen, GSC 80853.
17. Right valve, ventral view, x57, figured specimen, GSC 80854.

Figures 18, 19. *Rozhdestvenskayites*? sp.

18. Right(?) valve, x27, figured specimen, GSC 80936.
19. Right(?) valve, x33, figured specimen, GSC 80937.

Figures 20-27. *Undulirete mackenziensis* Copeland

20. Left valve, x60, hypotype, GSC 72599.
21. Right valve, x67, hypotype, GSC 72600.
22. Right valve, x67, hypotype, GSC 72602.
23. Left valve, x70, hypotype, GSC 72603.
24. Left valve, interior view, x70, hypotype, GSC 72604.
25. Right valve, interior view, x80, hypotype, GSC 80799.
26, 27. Left valve, interior view, x70, and x280, hypotype, GSC 80800.

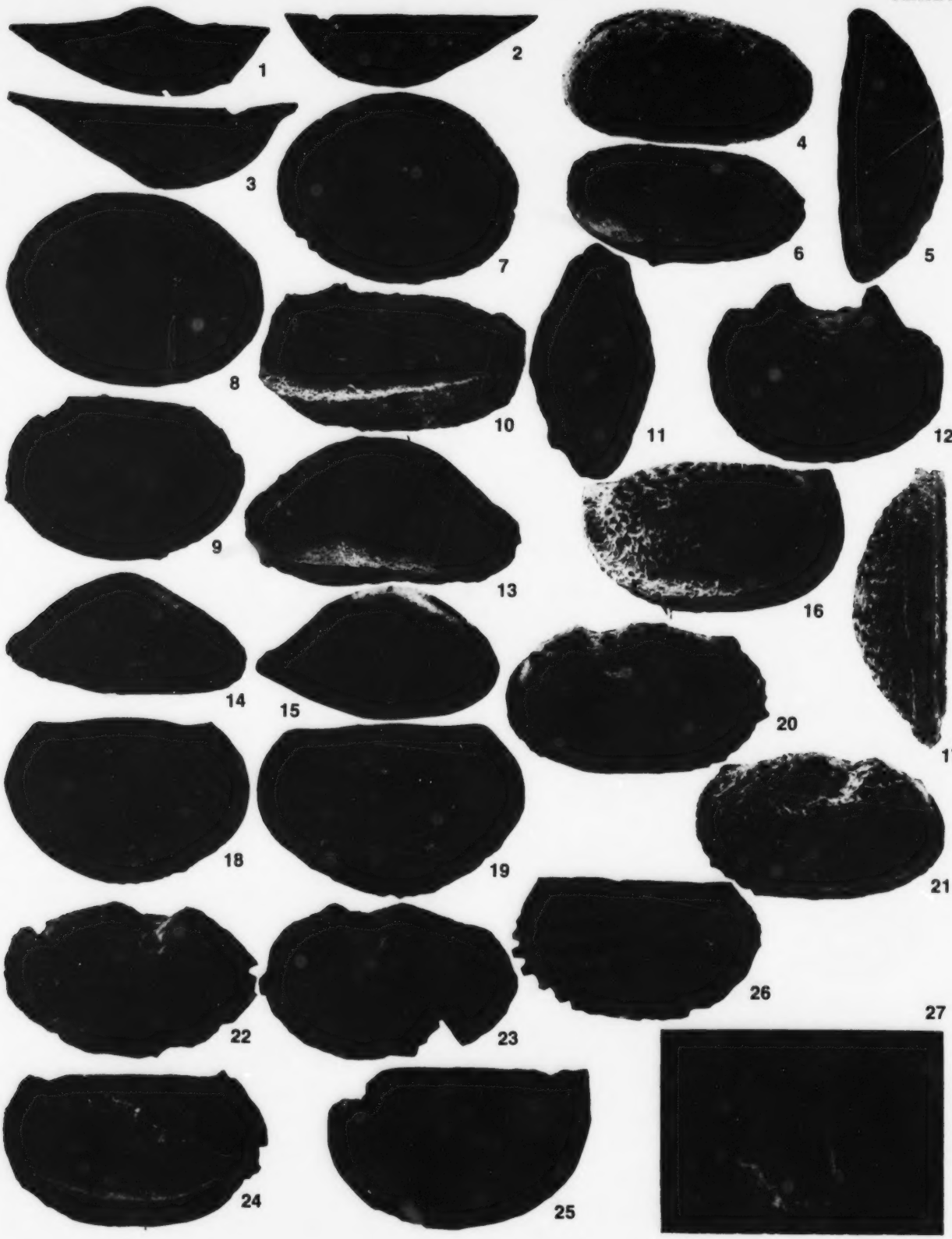
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PLATE 16

Silurian, Whittaker Formation

Figure 1. *Silenis symmetricus* Pranskevičius

Carapace, right lateral view, x25, locality AV1-341 m, hypotype, GSC 80893.

Figure 2. *Baschkirina*? sp.

Right valve, x26, locality AV3-60 m, figured specimen, GSC 80889.

Figures 3-5. *Cadmea inexplorata* Pranskevičius

3. Left valve, x20, locality AV3-60 m, hypotype, GSC 80890.

4. Right valve, x20, locality AV3-60 m, hypotype, GSC 80891.

5. Left valve, internal view, x20, locality AV3-60 m, hypotype, GSC 80892.

Figures 6, 7. *Tipperopsis quadrilineata* n. sp.

6. Right? valve, x32, locality AV2-11.5 m, paratype, GSC 80831.

7. Left? valve, x27, locality AV2-11.5 m, paratype, GSC 80832.

Figures 8-10. *Cooperatia lacrimosa* Copeland

8. Carapace, right lateral view, x30, locality AV1-320T m, hypotype, GSC 80824.

9. Left valve, internal view, x23.5, locality AV3-60 m, hypotype, GSC 80825.

10. Left valves, internal view, demonstrating moult retention or fortuitous preservation?, x25, locality AV3-60 m, hypotype, GSC 80826.

Figure 11. Beyrichiacean indet. 1

Right valve, x27, locality AV1-336 m, figured specimen, GSC 80887.

Figure 12. *Leptobolbina*? sp. 2

Left valve, x28, locality AV1-320 m, figured specimen, GSC 80888.

Figure 13. *Beecherella roddicki* n. sp.

Left valve, x33, locality AV3-60 m, paratype, GSC 80827.

Figures 14, 15, 18-20. *Leptobolbina plana* n. sp.

14. Left valve, heteromorph, x41, locality AV1-421 m, paratype, GSC 80873.

15. Left valve, heteromorph, x45, locality AV1-421 m, holotype, GSC 80874.

18. Left valve, x30, locality AV3-60 m, paratype, GSC 80875.

19. Right valve, x38, locality AV1-421 m, paratype, GSC 80876.

20. Left valve, interior view, x30, locality AV3-60 m, paratype, GSC 80877.

Figures 16, 17. *Leptobolbina*? sp. 1

16. Right valve, x24, locality AV1-341 m, figured specimen, GSC 80879.

17. Right valve, ventral view, x20, locality AV1-341 m, figured specimen, GSC 80880.

Figures 21-23. *Apatobolbina elongidolonata* n. sp.

21. Left valve, x36, locality AV3-155T m, paratype, GSC 80884.

22. Right valve, heteromorph, x26, locality AV3-60 m, holotype, GSC 80885.

23. Right valve, x45, locality AV3-155T m, paratype, GSC 80886.

Figures 24-26. *Berdanopsis* sp. cf. *Berdanopsis ursensis* Copeland

24. Right valve, heteromorph, x42, locality AV3-155T m, hypotype, GSC 80881.

25. Left valve, x46, locality AV3-155T m, hypotype, GSC 80882.

26. Right valve, heteromorph, x40, locality AV3-155T m, hypotype, GSC 80883.

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PLATE 17

Silurian, Delorme Formation

Figures 1, 2. *Silenis proteus* Pranskevičius

1. Right valve, interior view, x31, locality AV4-165A m, hypotype, GSC 72641.
2. Carapace, right lateral view, x20, locality AV2-256A m, hypotype, GSC 72642.

Figure 3. *Bairdiocypris* sp.

Carapace, left lateral view, x18, locality AV2-256A m, figured specimen, GSC 72643.

Figure 4. *Bairdiacypris subarctica* Copeland

Carapace, right lateral view, x22, locality AV2-256A m, hypotype, GSC 72643.

Figures 5-7. *Tubulibairdia*? sp.

5. Carapace, ventral view, x50, locality AV4-165T m, figured specimen, GSC 72645.
6. Carapace, dorsal view, x50, locality AV4-165T m, figured specimen, GSC 72646.
7. Carapace, dorsal view, x47, locality AV2-274.9 m, figured specimen, GSC 72647.

Figures 8, 9, 15. *Dizygopleura*? *borealis* n. sp.

8. Interior view, left valve, x30, locality AV4-165T m, paratype, GSC 72639.
9. Interior view, left valve, x30, locality AV4-165T m, paratype, GSC 72640.
15. Right valve, x28, locality AV4-165T m, paratype, GSC 72649.

Figure 10. "*Acanthoscapha*" *dorsiglobosa* n. sp.

Left valve, x28, locality AV4-126T m, holotype, GSC 72585.

Figure 11. *Microcheilinella* sp.

Carapace, right lateral view, x27, locality AV2-274.9 m, figured specimen, GSC 72648.

Figure 12. "*Beecherella*" sp.

Left valve, x30, locality AV4-107 m, figured specimen, GSC 72587.

Figures 13, 32, 33, 36. *Newsomites inequalis* n. sp.

13. Right valve, x40, locality AV4-126T m, paratype, GSC 72651.
32. Carapace, dorsal view, x40, locality AV4-240 m, paratype, GSC 72652.
33. Carapace, ventral view, x40, locality AV4-240 m, paratype, GSC 72653.
36. Carapace, right lateral view, x39, locality AV4-240 m, holotype, GSC 72654.

Figure 14. *Cadmea acuta* Copeland

Carapace, right lateral view, x17, locality AV2-274.9 m, hypotype, GSC 72650.

Figure 16. *Acanthoscapha* sp. cf. *A. decurtata* Bouček

Left valve, x28, locality AV4-107 m, hypotype, GSC 72584.

Figure 17. *Antijanusella spinosa* Copeland

Left valve, x20, locality AV2-256A m, hypotype, GSC 72656.

Figures 18, 19. *Libumella* sp. cf. *L. ambigua* (Lundin)

18. Lateral view, x40, locality AV4-165T m, hypotype, GSC 72513.
19. Lateral view, x33, locality AV2-274.9 m, hypotype, GSC 72514.

Figure 20. *Arcuaria delormensis* Copeland

Carapace, right lateral view, x27, locality AV2-274.9 m, hypotype, GSC 72528.

Figure 21. *Libumella*? sp. 1

Lateral view, x30, locality AV2-274.9 m, figured specimen, GSC 72657.

Figures 22, 23, 26-28. *Ockerella jordani* Copeland

22. Left valve, x33, locality AV2-274.9 m, hypotype, GSC 72580.
23. Left valve, x40, locality AV4-107 m, hypotype, GSC 72658.
26. Left valve, x33, locality AV2-256A m, hypotype, GSC 72581.
27. Left valve, x44, locality AV2-256A m, hypotype, GSC 72582.
28. Left valve, x60, locality AV2-274.9 m, hypotype, GSC 72583.

Figures 24, 25. *Tricornina* (*Tricornina*) *navicula* Bouček

24. Left valve, x40, locality AV4-107 m, hypotype, GSC 72576.
25. Left valve, x30, locality AV4-107 m, hypotype, GSC 72577.

Figure 29. *Ovornina* (*Tricornella*) *perryi* Copeland

Right valve, x33, locality AV4-107 m, hypotype, GSC 72572.

Figure 30. *Beecherella rhomboidalis* n. sp.

Right valve, x30, locality AV2-274.9 m, holotype, GSC 72613.

Figure 31. *Baschkirina*? sp.

Right valve, x28, locality AV2-274.9 m, figured specimen, GSC 72615.

Figure 34. *Spinobairdia dorsicornis* Copeland

Left valve, x26, locality AV4-107 m, hypotype, GSC 72655.

Figure 35. *Berounella spicata* n. sp.

Right valve, x39, locality AV4-107 m, paratype, GSC 72509.

Figure 37. *Saccarchites*? sp.

Left valve, x26, locality AV4-165T m, figured specimen, GSC 72705.

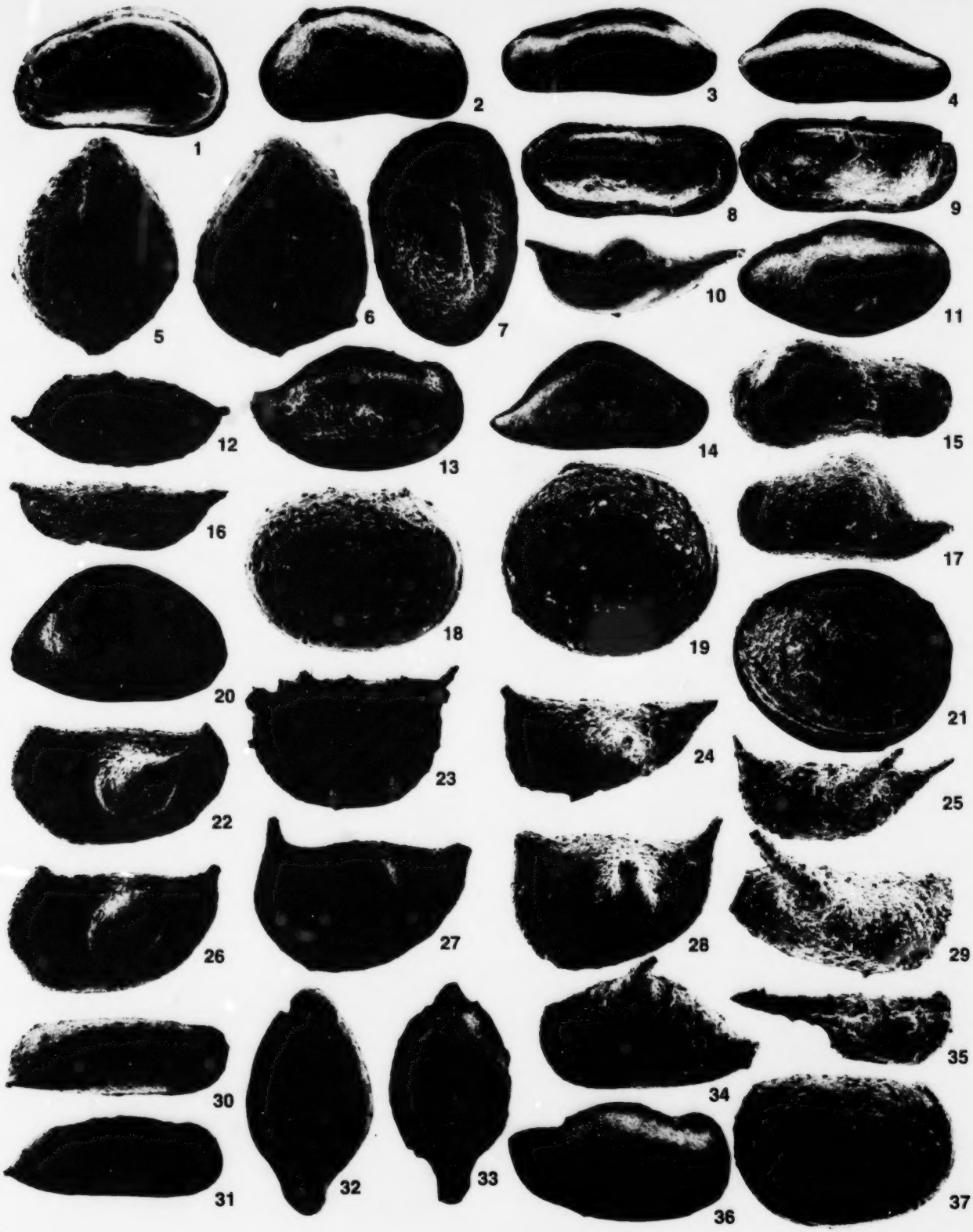
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PLATE 18

Silurian, Delorme Formation

Figures 1, 2, 20. *Ovomina* (*Tricornella*) *perryi* Copeland

1. Right valve, x30, locality AV1-589.8 m, hypotype, GSC 72570.

2, 20. Right valve, x27, 20 is tilted near ventral, locality AV1-589.8 m, hypotype, GSC 72571.

Figures 3, 27. *Baschkirina*? sp.

3. Right valve, x29, locality AV1-586.1 m, figured specimen, GSC 72614.

27. Carapace, dorsal view, x33, locality AV1-589.8 m, figured specimen, GSC 72611.

Figure 4. *Processobairdia delormensis* Copeland

Right valve, x33, locality AV1-586.1 m, hypotype, GSC 72616.

Figures 5, 6, 11. *Arcuaria delormensis* Copeland

5. Carapace, left lateral view, x25, locality AV1-590 m, hypotype, GSC 72527.

6. Carapace, left lateral view, x33, locality AV1-586.1 m, hypotype, GSC 72529.

11. Carapace, right lateral view, x27, locality AV1-590 m, hypotype, GSC 72530.

Figures 7, 8. *Longiscula*? sp.

7. Right valve, x20, locality AV1-586.1 m, figured specimen, GSC 72633.

8. Right valve, interior view, x25, locality AV1-590 m, figured specimen, GSC 72634.

Figure 9. *Bairdiacypris*? sp.

Right valve, x24, locality AV1-589.8 m, figured specimen, GSC 72635.

Figures 10, 12. *Arcuaria avalanchensis* Copeland

10. Carapace, left lateral view, x22, locality AV1-590 m, hypotype, GSC 72531.

12. Carapace, right lateral view, x17, locality AV1-589.8 m, hypotype, GSC 72532.

Figures 13, 14, 17. *Antijanusella spinosa* Copeland

13. Carapace, left lateral view, x18, locality AV1-590 m, hypotype, GSC 72533.

14. Right valve, x20, locality AV1-586.1 m, hypotype, GSC 72534.

17. Carapace, right lateral view, x20, locality AV1-589.8 m, hypotype, GSC 72535.

Figures 15, 16, 18. *Spinobairdia dorsicornis* Copeland

15. Left valve, x20, locality AV1-586.1 m, hypotype, GSC 72629.

16. Right valve, x24, locality AV1-589.8 m, hypotype, GSC 72630.

18. Right valve, x20, locality AV1-589.8 m, hypotype, GSC 72631.

Figure 19. *Aechminaria equalis* n. sp.

Left valve, x40, locality AV1-589.8 m, holotype, GSC 72518.

Figures 21, 22. *Tricornina* (*Tricornina*) *navicula* Bouček

21. Left valve, x25, locality AV1-589.8 m, hypotype, GSC 72574.

22. Left valve, x30, locality AV1-586.1 m, hypotype, GSC 72575.

Figure 23. *Acanthoscapha* sp. cf. *A. decurtata* Bouček

Right valve, x23.5, locality AV1-589.8 m, hypotype, GSC 72579.

Figures 24, 25. *Ockerella jordani* Copeland

24. Left valve, x33, locality AV1-589.8 m, hypotype, GSC 72588.

25. Left valve, x29, locality AV1-586.1 m, hypotype, GSC 72589.

Figure 26. *Ovomina*? sp.

Carapace, ventral view, magnification uncertain, broken, locality AV1-589.8 m, figured specimen, GSC 72632.

Figure 28. *Acanthoscapha* sp. cf. *A. decurtata* Bouček

Left valve, x25, locality AV1-586.1 m, hypotype, GSC 72573.

Figure 29. *Acanthoscapha subnavicula* Abushik

Left valve, x30, locality AV1-586.1 m, hypotype, GSC 72569.

Figures 30, 31. *Rozhdestvenskayites*? sp.

30. Carapace, lateral view, x20, locality AV1-590 m, figured specimen, GSC 72688.

31. Lateral view, x24, locality AV1-590 m, figured specimen, GSC 72689.

Figure 32. *Cooperatia lacrimosa* Copeland

Carapace, right? lateral view, x20, locality AV1-590 m, hypotype, GSC 72537.

Figure 33. "*Aparchites*" sp.

Specimen lost, x20, locality unknown.

Figure 34. *Billingsopsis planivelata* n. sp.

Left valve, x25, locality AV1-589.8 m, paratype, GSC 72524.

Figure 35. *Polenovula rara* n. sp.

Left valve, x33, locality AV1-589.8 m, holotype, GSC 72507.

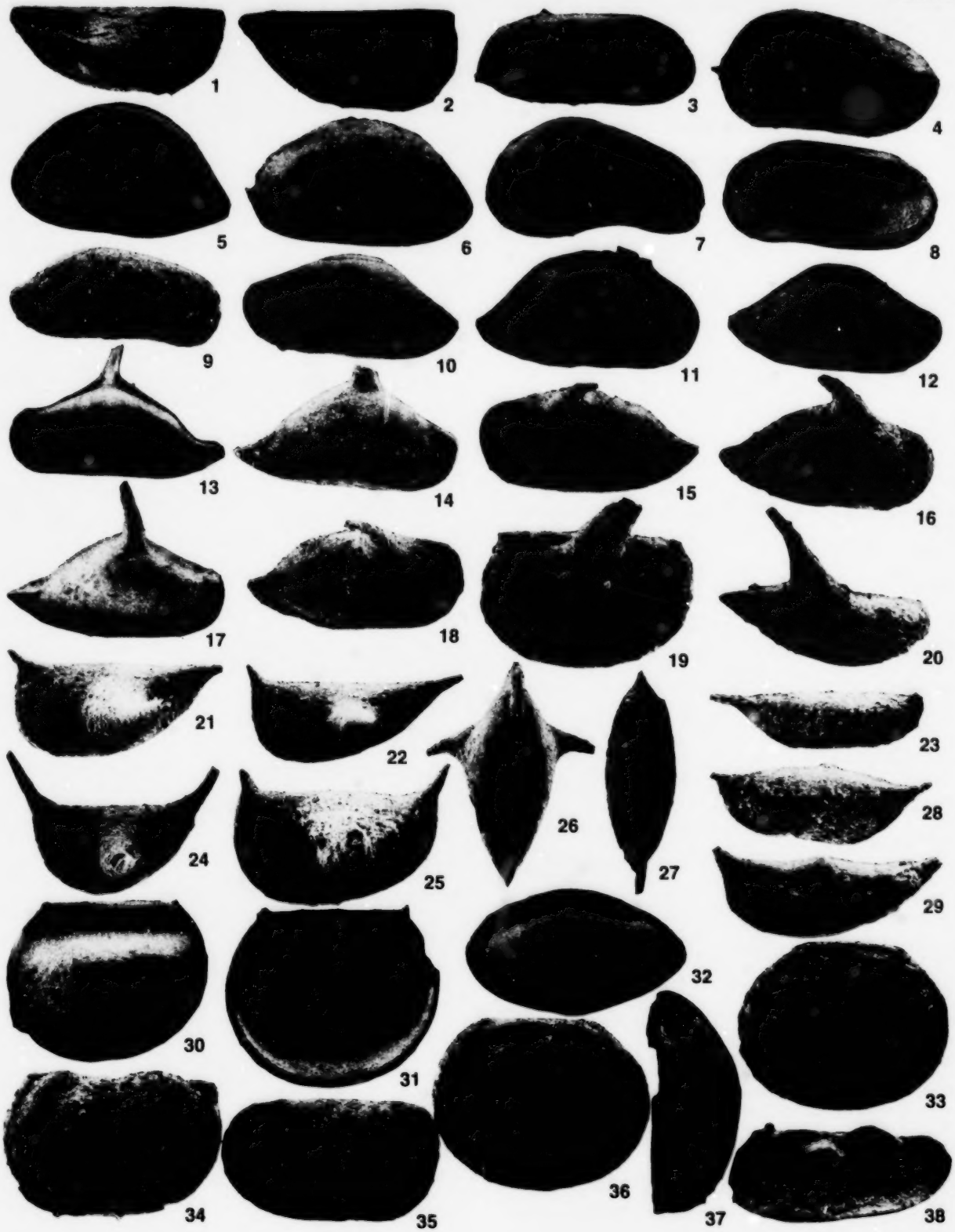
Figure 36. "*Aparchites*" sp.

Left? valve, internal, x30, locality AV1-589.8 m, figured specimen, GSC 72690.

Figures 37, 38. *Alaskabolbina trinodosa* n. sp.

37. Left valve, ventral view, x33, locality AV1-589.8 m, paratype, GSC 72498.

38. Left valve, x30, locality AV1-589.8 m, paratype, GSC 72499.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INDEX OF FOSSILS
(not including appendices)

Abditoloculina triloculata, **30**; Pl. 8, figs. 7, 8; Pl. 10, fig. 34, Pl. 11, figs. 3, 4

A. sp. cf. *A. triloculata*, **30**; Pl. 6, fig. 9

A.? sp., **30**; Pl. 12, fig. 2

"*Acanthoscapha*" *dorsicornis* n. sp., **40**; Pl. 5, fig. 21

"*A.*" *dorsiglobosa* n. sp., **40**; Pl. 15, figs. 1-3; Pl. 17, fig. 10

A. subnavicula, 40, **41**

A. sp. cf. *A. decurtata*, 40

Acantonodella, 29

Adelphobolbina, 31

Aechmina spp., 6, **13**; Pl. 1, figs. 8, 9; Pl. 2, figs. 13, 27, 28; Pl. 3, figs. 8, 9

A. bovina, 13

A. overi n. sp., **13**; Pl. 2, figs. 29, 30

A. wolfensis n. sp., 6, **13**; Pl. 1, figs. 10, 11, 14, 15; Pl. 4, fig. 31

Aechminaria equalis n. sp., **30**; Pl. 5, fig. 18; Pl. 18, fig. 19

A. nodosa, 30

A. robusta, 30

?*Alanella bohemica* var. *decurtata*, 40

A. decurtata, 40

Alaskabolbina, 38

A. paucilineata, 37

A. trinodosa n. sp., 11, **37**; Pl. 5, figs. 9-14; Pl. 9, figs. 21, 22, 24, 25, 28, 29; Pl. 11, fig. 10; Pl. 18, figs. 37, 38

A. sp., 38

A.? sp., **37**; Pl. 12, fig. 19

Ampletochilina, 38

Anataphrus, 6

Anticostiella, 14

A. ellisensis, 14

A. reticulata n. sp., 6, **14**; Pl. 1, fig. 13; Pl. 2, figs. 19-25

Antijanusella spicata n. sp., **43**; Pl. 4, fig. 24; Pl. 5, figs. 31, 32

A. spinosa, **43**; Pl. 17, fig. 17; Pl. 18, figs. 13, 14, 17

Aparchites, 37

Apatobolbina elongidolonata n. sp., **19**; Pl. 15, fig. 10; Pl. 16, figs. 21-23; Figure 12C

A. granifera, 19

A. michiganensis, 19

A. simplicidorsata, 19

A. sp., **19**; Pl. 4, fig. 11

A.? sp., **19**; Pl. 4, fig. 8; Pl. 9, fig. 30; Figure 12, D

Arcuaria avalanchensis, **45**; Pl. 4, fig. 29; Pl. 6, fig. 11; Pl. 18, figs. 10, 12

A. delormensis, **45**; Pl. 15, figs. 13-15; Pl. 17, fig. 20; Pl. 18, figs. 5, 6, 11

A. sp. cf. *A. sineclivula*, **46**; Pl. 3, fig. 24

Atrypella, 4

Avalanchella, 21

A. bicristata n. sp., 11, **21**; Pl. 8, figs. 25-31; Pl. 9, figs. 2-8, 10; Pl. 10, figs. 23, 24; Pl. 12, fig. 1; Figure 12, I

A. b. micropunctata n. ssp., **21**; Pl. 8, fig. 32; Pl. 9, fig. 1

Bairdiacypris incurvatus, 16

B.? *subarctica*, **40**; Pl. 17, fig. 4

B.? sp., **40**; Pl. 4, fig. 27; Pl. 18, fig. 9

Bairdiocypris longus, **44**; Pl. 14, figs. 1, 2

B. sp., **44**; Pl. 17, fig. 3

Baschkirina? sp., **44**; Pl. 5, fig. 17; Pl. 16, fig. 2; Pl. 17, fig. 31; Pl. 18, figs. 3, 27

Beecherella carinata, 41

"*B.*" *cristata*, 41

B. rhomboidalis n. sp., **41**; Pl. 12, figs. 20-28; Pl. 17, fig. 30

B. roddicki n. sp., **41**; Pl. 4, figs. 6, 7; Pl. 5, figs. 33, 34; Pl. 16, fig. 13

"*B.*" sp., **41**; Pl. 17, fig. 12

Berdanopsis? *planus* n. sp., **26**; Pl. 13, figs. 24-26

B. royalensis, **26**

B. ursensis, **26**; Pl. 13, fig. 23

B. sp. cf. *B. ursensis*, **26**; Pl. 16, figs. 24-26

Berounella spicata n. sp., **42**; Pl. 10, fig. 25; Pl. 17, fig. 35

B. rostrata, 42

B. sp., 42

Beyrichia (*Beyrichia*), 11, 25

B. dissecta, 33

B. (*B.*) *keslingi* n. sp., 10, 11, **24**; Pl. 6, figs. 12-16, 18-21; Pl. 12, figs. 12, 15

B. (*B.*) *lenzi*, 10, 11, **24**; Pl. 7, fig. 15; Pl. 10, figs. 1-14

B. (*incerti subgeneris*) *erinacea*, 25

B. (*Scabribeyrichia*), 25

B. (aff. *Scabribeyrichia*) sp., 25

B. (*Simplicibeyrichia*), 25

B. (*S.*) *globifera*, 25

B. (*S.*) sp 1, **24**; Pl. 11, fig. 15

B. (*S.*) sp. 2, **25**; Pl. 12, fig. 11

Beyrichiacean indet. 1, **28**; Pl. 16, fig. 11

Beyrichiacean indet. 2, **28**; Pl. 11, figs. 1, 2

Beyrichiacean indet. 3, **28**; Pl. 8, fig. 1

Beyrichiacean indet. 4, **28**; Pl. 4, fig. 4

Bighornia, 6

Billingsopsis, 31

B. planivelata n. sp., **31**; Pl. 5, figs. 7, 8; Pl. 18, fig. 34

Bingeria cyamoides, 28

Bingeria? sp., **27**; Pl. 4, fig. 1

Bolbiprimitia, 22

B. inaequalis, 20

Bollia sp., 12; Pl. 3, fig. 16

Bromidella, 14

B. obesa, 6, 14; Pl. 2, figs. 6-8

Cadmea acuta, **44**; Pl. 17, fig. 14

C. inexplorata, **44**; Pl. 16, figs. 3-5

Camsella n. gen., **22**

C. nodosa n. sp., **22**; Pl. 9, figs. 11, 12, 16, 18; Pl. 10, figs. 27, 28, 32; Pl. 11, figs. 24-26; Figure 12, J

Clintiella, **22**

Cooperatia lacrimosa, **43**; Pl. 4, figs. 22, 23; Pl. 16, figs. 8-10; Pl. 18, fig. 32

Cornikloedenina lorangerae, 27

C.? tuberculata n. sp., **26**; Pl. 8, figs. 5, 6; Pl. 13, figs. 18-22

Craspedobolbina? sp., **20**; Pl. 3, figs. 29, 30; Pl. 4, fig. 32; Figure 12, F

C. (*Mitrobeyrichia*) *lundini*, **20**; Pl. 6, figs. 28-30; Figure 12, H

C. (*M.*) *siveteri*, **20**; Pl. 6, figs. 10, 17, 22-27; Figure 12, G

C. (*M.*) *variolata*, 20

Cryptolithus, 6

Cryptolopholobus, 23

C. semilaqueatus, 23

C. sp., **23**; Pl. 13, fig. 29

Cytherellina, 16

Cystomatochilina densistriata, 14

C. reticulotiara, 14

C. tiara, 14

C. umbonata, 14

C. sp., **14**; Pl. 1, fig. 16; Pl. 2, fig. 26

Delormobolbina n. gen., **38**

D. binodosa n. sp., **38**; Pl. 11, figs. 7-9, 11, 12

Dilobella, 15

Distomodus kentuckyensis, 5, 10, 11

Dizygopleura, 11

Dizygopleura? borealis n. sp., **36**; Pl. 5, fig. 15; Pl. 10, figs. 29-31; Pl. 17, figs. 8, 9, 15

D. swartzi, 36

Dolichoscapha escharota, 19

D. minuta n. sp., **19**, 20; Pl. 9, fig. 31; Pl. 10, fig. 15; Pl. 11, figs. 16, 18-20; Pl. 12, fig. 8; Pl. 14, fig. 8; Figure 12, E

D. sp. cf. *D. minuta*, **19**; Pl. 11, figs. 28, 29

Drepanellid indet. 1, **29**; Pl. 14, fig. 21

Drepanellid indet. 2, **29**; Pl. 14, figs. 20, 22

Drepanellina clarki, 11

Echinobeyrichia n. gen., **25**

E. spinosa n. sp., **25**; Pl. 7, figs. 1-14, 16-32; Pl. 12, figs. 13, 14, 16

Eoacantonodella n. gen., 11, **29**

E. zaspelovae n. sp., **29**; Pl. 13, figs. 1-10

Eoaquapulex, 15

E. socialis, 15

Eoflaccivelum n. gen., **31**

E. blussoni n. sp., **32**; Pl. 8, figs. 14, 15, 17-20, 23, 24; Pl. 10, figs. 18-20; Pl. 11, figs. 5-6.

E. originalis, 32

Eohollina, 14

E.? sp. cf. *E.? irregularis*, 14

Euprimitia gamachei, 5

Eurekabolbina, 38

Eurybolbina sp., **31**; Pl. 3, fig. 22

Eurychilina? sp. indet 1, **13**; Pl. 3, figs. 4-6

Flaccivelum, 32

Gabrielsella, **22**

G. reticulata n. sp., 11, 22, **23**; Pl. 8, figs. 21, 22; Pl. 9, figs. 9, 13-15; Pl. 11, fig. 17; Pl. 12, fig. 5; Pl. 14, figs. 27, 28

Garniella, 21

G. lineolata, 21

Hamulinavis, 21

Hibbardia lacrimosa, 20

Homeokiesowia sp., 6, **15**; Pl. 2, figs. 15-17

H. frigida, 15

H. margaritata, 15

Hyrsinobolbina, **21**; Pl. 4, fig. 2

Jagatiella, 22

Janius, 4

Janusella? *latispinosa*, **44**; Pl. 5, figs. 27-29

Kiesowia, 33

Kiesowia? *decinodosa* n. sp., **33**; Pl. 8, fig. 2; Pl. 12, figs. 29-31

Kiltsiella, 23

K. sarvi, 22

Kirkbyella (*Berdanella*) *belli* n. sp., **30**; Pl. 10, fig. 26; Pl. 11, figs. 21, 22

K. (*B.*) *obliqua*, 30

Kockelella walliseri, 6

Kolmodinia martinssoni, **29**; Pl. 11, fig. 23

K. spinosa, **29**; Pl. 8, fig. 3

Krausella spp., 6, **17**; Pl. 1, figs. 4, 5, 24; Pl. 3, figs. 1, 2

Lambeodella n. gen., **14**

L. uniloculata n. sp., 6, **15**; Pl. 1, figs. 12, 17-23, 25-28; Pl. 2, figs. 1-5; Figure 11

Leperditella sp. cf. *L. globosa*, **16**; Pl. 1, figs. 6, 7; Pl. 3, fig. 15

Leptobolbina hypnodes, 18

L. plana n. sp., **17**; Pl. 16, figs. 14, 15, 18-20; Figure 12, A

L. quadricuspidata, 18, 19

L. tricuspidata, 19

L.? sp., 11

L.? sp. 1, **18**; Pl. 12, fig. 7; Pl. 16, figs. 16, 17; Figure 12, B

L.? sp. 2, **19**; Pl. 3, figs. 25, 28; Pl. 4, figs. 16, 17, 28, 30; Pl. 16, fig. 12

Libumella sp. cf. *L. ambigua*, **33**, 34; Pl. 6, figs. 1, 2; Pl. 14, fig. 26; Pl. 15, figs. 8, 9; Pl. 17, figs. 18, 19

L.? *cardinalis* n. sp., **34**; Pl. 4, fig. 25; Pl. 6, fig. 3

L. circulata, 34

L. discoides, 34

L. marginata, **33**; Pl. 15, fig. 17

L. sp. indet., **34**; Pl. 3, figs. 27, 31; Pl. 4, figs. 3, 5; Pl. 10, fig. 33

L. sp., 34

L.? sp. 1, **34**; Pl. 17, fig. 21

Limbinaria, 35

Limbinariopsis n. gen., **35**

L. sinuata n. sp., **35**; Pl. 5, figs. 1, 2

Lomatobolbina craspedota, 32

L.? sp., **32**; Pl. 10, fig. 16

Longiscula, 45

L.? sp., **45**; Pl. 18, figs. 7, 8

Lophoctenella, 23

Medianella? sp., **46**; Pl. 6, fig. 4

Microcheilinella spp., **46**; Pl. 14, figs. 6, 7; Pl. 17, fig. 11

Neodrepanella, 29

Newsomites inequalis n. sp., **40**; Pl. 17, figs. 13, 32, 33, 36

Noviportia, 23

Nudista sp., **23**; Pl. 8, fig. 13, Pl. 10, fig. 22; Pl. 12, fig. 6

N. carriticuspis, 23

Ockerella jordani, **43**; Pl. 5, figs. 22, 24; Pl. 17, figs. 22, 23, 26-28; Pl. 18, figs. 24, 25

O. longula n. sp., **43**; Pl. 5, fig. 26

Oepikella sp., 6, **15**; Pl. 2, figs. 10-12

Oulodus? *nathani*, 6, **15**; Pl. 2, figs. 10-12

Ovornina (*Tricornella*) *perryi*, 5, **43**; Pl. 5, fig. 19; Pl. 17, fig. 29; Pl. 18, figs. 1, 2, 20

O.? sp., **43**; Pl. 18, fig. 26

Ozarkodina sagitta bohemica, 6

Palaeocopid indet. 1, **39**; Pl. 8, fig. 16

Palaeocopid indet. 2, **39**; Pl. 4, fig. 10

?Palaeocopid indet. 3, **39**; Pl. 12, figs. 3, 4

Paranoviportia, 22

P.? sp., **22**; Pl. 15, figs. 16, 17

Parasclerites, 16

Parulrichia? sp., **12**; Pl. 3, fig. 3

Perrybolbina n. gen., 23

P. bicuspidata n. sp., **24**; Pl. 14, figs. 9-19; Pl. 15, figs. 11, 12

Phelobythocypris sp., **17**; Pl. 3, fig. 7

P. cylindrica, **17**; Pl. 2, fig. 18

Pheloparasclerites n. gen., 16

P. berdanae n. sp., **16**; Pl. 3, figs. 17-19

P. incurvatus, 16, 17

Platybolbina, 11

P. (*Reticulobolbina*), 11

P. (*R.*) *lenzi*, 5, 6, 13; Pl. 1, figs. 1-3

Pleurodella, 15

Pleurodella costata, 15

Polenovula rara n. sp., **35**; Pl. 11, figs. 13, 14; Pl. 18, fig. 35

P. recta, 35

Praepaegnium, 38

Pribylites bimarginatus, 36

P.? sp., **36**; Pl. 3, fig. 26

Primitia? sp., **16**; Pl. 2, fig. 14

Primitiella sp. 1, **36**; Pl. 13, fig. 17

P. sp. 2, **36**; Pl. 3, fig. 20

Primitiopsid? indet., **35**; Pl. 14, figs. 23-25

Processobairdia delormensis, **39**; Pl. 5, fig. 16; Pl. 18, fig. 4

Pseudobeyrichia cristata n. sp., **27**; Pl. 8, figs. 9-12

P. ventrilirata, 27

Pseudorayella? sp., **46**; Pl. 12, fig. 17

Pterospathodus amorphognathoides, 4, 6

P. celloni, 10

Quadritia (*Krutatia*), 33

Q. (K.) *tomelini*, 33

Q. (*Quadritia*), 33

Quasibollia, 12

Retisacculus, 22

"*Rozhdestvenskayites*" sp. cf. "*R.*" *auriculiferus*, **36**, 37; Pl. 10, fig. 21

R. diutuma, 36

"R." sp., 37

R.? sp., **37**; Pl. 15, figs. 18, 19; Pl. 18, figs. 30, 31

Saccarchites? sp., **28**; Pl. 3, fig. 23; Pl. 4, figs. 9, 19, 33; Pl. 17, fig. 37

Schmidtella? sp., **16**; Pl. 2, fig. 9

Schweyerina, 29

Shidelerites? *laterospinosus* n. sp., 41; Pl. 5, fig. 30; Figures 13a-e

S. typus, 42

S. yukonensis, 42

Signetopsis reticulata n. sp., **39**; Pl. 9, fig. 20; Pl. 13, fig. 16

S. semicircularis, 39

Silenis mawii?, **45**; Pl. 6, figs. 5, 6

S. proteus, **45**; Pl. 14, figs. 3-5; Pl. 17, figs. 1, 2

S. symmetricus, **45**; Pl. 16, fig. 1

Spinobairdia dorsicornis, **40**; Pl. 17, fig. 34; Pl. 18, figs. 15, 16, 18

Spinosteusloffina n. gen., **47**

S. multispinosa n. sp., **47**; Pl. 13, figs. 12-15

Stelckaspis sinedentata, 10

Steusloffina cuneata, 5

S. sp. cf. *S. cuneata*, 6, **17**; Pl. 3, figs. 10-14

S.? *symmetrica* n. sp., **47**; Pl. 4, figs. 20, 21; Pl. 6, fig. 7

S. ulrichi, 47

Stroterobolbina? sp., **20**; Pl. 8, fig. 4

Tetradella, 15

Thaerodonta, 6

Tipperopsis n. gen., **37**

T. quadrilineata n. sp., **37**; Pl. 6, fig. 8; Pl. 16, figs. 6, 7

Treposella, 21

T. borealis, 20

T. lyoni, 5, 20, 21

T. stellata, 21

Tricomina (*Tricomina*) *navicula*, **42**; Pl. 5, figs. 23, 25; Pl. 17, figs. 24, 25; Pl. 18, figs. 21, 22

Triemilomatella prisca, 31

T.? sp., **31**; Pl. 5, figs. 5, 6

Tubulibairdia sp., **46**; Pl. 4, fig. 26; Pl. 15, figs. 4-6; Pl. 17, figs. 5-7

Undulirete mackenziensis, **34**; Pl. 9, figs. 17, 19, 23, 27; Pl. 15, figs. 20-27

U.? sp., **34**; Pl. 3, fig. 21

Venzavella? sp., **34**; Pl. 5, figs. 3, 4; Pl. 13, fig. 11

Voronina? sp., **44**; Pl. 4, figs. 12-14

Warthinia, 14

W.? sp. cf. *W.*? *irregularis*, 14

Welleria, 27

Welleriella prostrata, 27

W.? sp., **27**; Pl. 11, fig. 27

Welleriopsis jerseyensis, 27

W.? sp., 27; Pl. 10, fig. 17

Whittakerites planatus, 4

Winchellatia berdanae n. sp., **32**; Pl. 12, fig. 9

W. lansingensis, 32

W. longispina, 32

W. minnisotensis, 32

W.? sp., **32**; Pl. 13, figs. 27, 28

Yukonibolbina, 38

Y.? sp. 1, **38**; Pl. 9, fig. 26; Pl. 12, fig. 10

Y.? sp. 2, **38**; Pl. 4, fig. 15

Zygobolba, 23